THE BOOK OF SCHOOL HANDWORK

AN ENCYCLOPÆDIA OF EDUCATIONAL HANDWORK SUBJECTS, METHODS, MATERIALS, TOOLS, ORGANISATION, ETC.

Written by the Leading Authorities on, and Leading Teachers of, Handwork in the British Isles

EDITED BY

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THE BOOK OF SCHOOL HANDWORK

XXIX. RECENT DEVELOPMENTS IN MANUAL TRAINING, WITH SPECIAL REFERENCE TO THE TEACHING OF JOHN DEWEY

By J. J. FINDLAY, M.A., PH.D.

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Two Phases of Manual Training.—The Manual Training movement, in Europe and America alike, has passed through two very distinct phases: Otto Salomon, of Nääs, may be taken as the chief example of the one school, and John Dewey of the other. Comparisons are often odious, and little is gained by setting up two authorities in rivalry; I will assume that the reader has secured elsewhere sufficient acquaintance with the Sloyd pedagogy and content myself with indicating the salient features of a practical character which are comprised in Dewey's plans for educating young children. The reader can then make his own comparisons.

The Experimental Work of John Dewey.—It must be premised that Dewey is not in any sense a specialist in manual training or craft work. He is a psychologist, or rather a philosopher who adheres to that group of thinkers called Pragmatists. Special circumstances led him many years ago to take an interest in children's development and to direct the proceedings of a small school. This work brought him to see the importance of manual training, not as an isolated "subject," but as part of a curriculum in which mathematics, history, geography, language are equally important. In this school there were some very young

children, and these were taught largely on Froebelian lines; although Dewey diverges quite definitely (see Dewey, *School and Child*, pp. 48–62) from the strict Froebelian kindergarten. But his chief constructive reforms were concerned with children aged seven to twelve, and it was in this field that his influence was so widely exerted in the United States. I say "was" rather than "is," because although the effect of this work abides, Professor Dewey himself, on coming to New York from Chicago in 1905, gave up his school, and now confines his investigations to the more abstract relations of psychology and pedagogics.

Summary of Principles.—The essence of these reforms can be summarised in a few sentences.

(*a*) They begin with an interpretation of the child's outlook:—He is concerned with society, *i.e.* with the behaviour of the individuals about him, but his desire is not to reflect upon behaviour or discuss it: rather it is to occupy himself, intelligently but always practically and seriously, with materials and tools which represent this behaviour. The term of "occupation" is adopted to signify (Dewey as above, p. 81) "a mode of activity on the part of the child which reproduces, or runs parallel to, some form of work carried on in social life."

(*b*) But since modern adult activities are complex and their nature disguised by all the elaborations of trade and manufacture, a simpler style of occupation is proposed, more congenial to the simple, undifferentiated life of the child—the scissors, *e.g.* are appropriate to the child rather than the sewing machine. Thus the teacher finds that the theory of culture epochs, of parallelism between the child and the race, affords a rough line of guidance in the selection of these occupations, since the life of our forefathers, in domestic activities, weaving, cooking, building, were simple, and at the same time highly intellectual and purposeful.

(*c*) Thereupon follows the line of correlation between craft and culture. The story of primitive man is not the story of mere barbarians, but of great and worthy epochs in human development which are enshrined in literature: Hiawatha, Ulysses, Beowulf, and in sacred story the lives of the patriarchs and of Egypt, these are phases of social experience which appeal to the child not merely as story, but as practical life, with problems con-

cerning primary human needs, in food, clothing, shelter, such as the child finds (or should find) presented to his own daily experience.

(d) Many teachers misunderstand the course of this argument and suppose that Dewey intended the children merely to "play" with these stories, making models of Beowulf's armour or of Ulysses' raft. Now while such play is quite in order as an accessory or side show, helpful (like all imitative art and drama) to the understanding of life, this is not the essence of the scheme. What the child supremely needs to understand is his own life, his daily needs in food, clothing, and shelter: the problems presented to him are not the problems of the past, but these are to be applied, wherever possible, to present situations. Thus, when he has sown wheat, and ground a little of it to help to understand the story of Joseph in Egypt, he will actually make bread for his own table, and learn all he can by observation and by personal work of what bread-making means to himself and his own circle.

Obviously this application cannot be made so readily in all fields of domestic and industrial activity. A child can help to make bread—the present writer has frequently shared excellent stuff produced by school children for their lunch—but he cannot make furniture or weave clothes. Nevertheless he can go far enough in these activities and gain some sympathetic understanding of the handicraft world which surrounds him.

Criticism, leading to a Fifth Principle.—Here we have summarised some general principles of procedure. The practical teacher may very fairly say that the principles are too general, and do not provide him with a scheme or syllabus which he can copy. The older plans for Manual Training do provide such schemes, for they are based upon the execution of a sequence of "models," the order being determined by the mastery of successive points in technique. One scheme will be concerned with models in wood, another with cardboard models, another perhaps with a raffia material. But the new "school" finds no use in a series of models, for the execution of any piece of work in a school such as Dewey conducted may demand the employment of a variety of materials and tools regardless of any consideration of a sequence in technical skill.

We may state this as a fifth general principle (*e*). Up to the age of twelve or thirteen, handicraft work should employ a variety of tools and materials—any, in fact, which the scholar and teacher can procure, to enable the end to be achieved. Hence the specialisms of modern industry are not the teacher's guide, but the undifferentiated activities of early man who was at once carpenter and builder, weaver and artist. His power was displayed, not in the isolated output of a developed technique, but through the resourcefulness of a product which relied on whatever came to hand.

Difficulty of prescribing a detailed Syllabus.—Thus, by way of syllabus all that such a school as that of Dewey can supply is the indication of "problems" for investigation, arising out of the varied interests, historical or otherwise, created by school studies. For example (*loc cit.* p. 80), the American boy will be attracted to study the fascinating life of the American Indians. To grasp this adequately, the class must make a wigwam on a vacant patch of land. They will be left to their own resources as much as possible, but will welcome the advice and control of the specialist manual instructor when they get into difficulties. If the class is large, a few will be deputed to construct the tent; others can make Indian dresses, pottery, etc. All the arts with a large variety of tools and material are "requisitioned": much of this cannot be ordered from the store room of the Education Committee; but failure in that respect only stimulates teachers and taught alike to greater independence and resourcefulness.

Thus the syllabus reduces itself, as regards Manual Training, to a mere indication of the studies on which the successive standards or classes are engaged, in history, literature, nature knowledge, with a list of possible articles or objects such as may be constructed as necessary means for understanding the life of the people who are being studied, or, in the case of nature knowledge, objects which are being needed in the garden or in the care of plants and animals. Plant pots, window boxes, flower borders, *e.g.* ought to be made, or partly made, by children who want to use such, and not provided all complete by the beneficence of older folk.

Further Investigation by the Present Writer and Colleagues.

—I have outlined very briefly what appears to be the essence of the reform, as regards handicraft, of which John Dewey has been the leading exponent in America. Investigators are not, however, resting on their oars, and more recent inquiries, while accepting the importance of the historical development from dug-outs to waterplanes, as one line of work, point to the need for associating the help of the manual instructor with children's development in other directions.

For we must recognise that the child does not "live" in the past; he can play in it, *i.e.* he enjoys the art of fancifully putting himself and his fellows into the simple dramatic situations which past story opens up; but play, after all, is a luxury, and neither child nor adult develops wholesomely if his environment is severed from the present. Handicraft is essentially labour, toil, drudgery: it is conditioned by the fundamental law "in the sweat of thy face thou shalt eat bread."

Our schools have been regarded too much as places where children (in all types of school and all ranks of society) can escape the rigour of that law. In our mistaken regard for their tender years we have been inclined to let them grow up in ignorance of its meaning; ignorant, that is, because they are not permitted to take a real personal share in the toil by which their needs are met. If it is true that the life and ways of the ancient world can be only understood by children when they use their hands in constructing objects to represent that life, it is equally true that our modern drab world of toil can be only understood by motor activity which shares that toil.

Hence we find in recent years that attention is being given to a group of pursuits not usually reckoned with the handicrafts, but they are essentially of the same nature and appeal psychologically to the same side of child life: they are usually called domestic or social activities. The child, so far as his powers permit, is invited to share in the work of the caretaker, the carpenter, the craftsman of any kind, who helps to make his school, his classroom, or his playground orderly and convenient. The room has to be dusted: it is his room, why should he not keep it clean—or, at any rate, try to do so: and, by trying, learn what such work means? Obviously, there is much that lies

beyond his power, obviously, too, if all his time were to be absorbed in such work, he would not have the requisite time for other studies. But he should do enough to enable him to find his place among his fellow-men as a manual worker, to realise his dependence upon his fellows for the common benefits of daily life, so that henceforth he will not accept the comforts and indulgences provided for those who toil, without a sympathetic understanding of the cost (not in money, but in hard labour) which these entail. This is the ethical contribution which crafts as conducted within the school walls should make: more important, it would seem, for the welfare of our modern society than the contribution which a manual instructor can offer who merely regards his task as concerned with the psychological development of the individual, or with his vocational efficiency.

Craft as the Interpreter of Culture.—Now, while this trend towards the association of Manual Training with domestic activities is very important, it should not be pursued so as to derogate from the cultural value of handicrafts, *i.e.* their relationship to history. And in the "Dewey" School it will be seen that the emphasis placed on prehistoric times is carried forward after the age of eight in a syllabus of history proper, in which naturally enough the United States plays the chief rôle. In a European school this trend may be expected to be far more emphasised, since there is more history to be dealt with. Hence in the Fielden School, from which details are supplied below, it will be observed that humanities, art, and crafts are largely treated as one syllabus; the manual instructor is also a teacher of English history; or, to be more exact, the teacher of these classes is, to the best of his powers, both a craftsman handling a variety of tools and a scholar exploring many fields in the public and domestic life of our ancestors. Thus the crafts render a double service: first and foremost as part of the daily toil which supports mankind; secondly, as an interpretation of the arts, the ideas, the conflicts by which our English people have won our great heritage of culture.

Programmes still in the Experimental Stage.—The illustrations given below are confined to the Chicago school founded by Professor Dewey, and to the Fielden School, but there are many

schools, or individual teachers, who are working more or less tentatively on such lines. And neither these two schools nor others can be said to have laid down a definite programme that can be copied in detail. In fact, the authors of these programmes would be the last to desire such imitation, since it is only by the varied independent activity of teachers acting in co-operation that the value of the principles can be tested.

Further, it should be noted that these principles have been tested with small classes. Professor Dewey secured the co-operation of a large corps of teachers well equipped both in history, science, handicrafts, and the fine arts; and the children were divided into small groups, often less than twelve in number. The Fielden School has not had such abundant resources, but even here the classes are restricted to about twenty children, and a teacher is provided for every class. In both schools whatever success was achieved must be traced to the willingness of a teaching staff to co-operate year by year in working out pedagogic problems based upon principles of child development. Where such co-operation can be secured, the function of the manual instructor is greatly modified from that which now commonly obtains. His expert knowledge of tools and materials is available not only to help the children to secure a moderate skill in woodwork, needlework, or gardening, but to help every other teacher to second the children's efforts, from the kindergarten onwards, in a united scheme of school pursuits.

Exigencies of time table require that separate periods should be assigned week by week to arts and crafts, but the time table and the specialist teacher are not the governing factors: these are subordinated to the developing needs of the young mind which explores the unknown world, both intellectual and practical, as one problem. So regarded, the manual instructor is no longer a mechanic, entrusted with an inferior office, but is the indispensable colleague and adviser both of teachers and children. The expert in humanistic studies may start the children on a field of exploration, but the satisfaction of these instincts can only be reached, either by adults or children, with the aid of the craftsman. Thus the next step to be taken as regards the school organisation of handicrafts is to strike a close alliance, based on

mutual respect, between the experts: the co-operation of real teachers will replace the isolation and antagonism of specialists.

Illustrations of School Programmes.—I. From *The Elementary School Record* (Chicago University Press, 1900, o.p.) A portion of this volume, covering the pursuits of children up to the age of nine has recently been issued by the Froebel Society under the title of *The Dewey School*, 1913. The portions by Professor Dewey himself, expounding the principles of genetic psychology underlying the curriculum, were edited by the present writer in *The School and the Child* (Blackie & Son, 1906).

As regards handicrafts and domestic activities the following were undertaken at the age specified :—

AVERAGE AGE FIVE.—Centring round "The Home": Constructive work.—Iron holder, rug, chair, house from manilla paper, 9 by 11 inches, weaving of felt, cloth, raffia, rattan, candlewick, use of pasteboard boxes, picnic basket and hanging basket (raffia) for flowers. In the spring, playthings, tops, and kites. Cooking cereals and stewed fruits for lunch: rough measurements were necessary and were readily appreciated.

AVERAGE AGE SIX.—*Autumn*, a typical grain farm: Flail, mortar to grind corn, model of fences (rails and posts), a harrow, measures (bushel, half bushel, etc.), made in cardboard and used. Afterwards a sheep farm was introduced and provided material for craft work in the "shop."

Winter and Spring.—Present industrial occupations: cotton, sugar, rice, lumber, quarrying, shops and stores. For each of these there was some "shop" work, *e.g.* sleds, carts, harrows.

Cooking.—As in previous year, but number work emphasised; exact fractions ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$) used. The work for luncheon (including setting the table, serving, waiting, washing) was "real," whereas the other occupations partook necessarily of the nature of play and drama.

AVERAGE AGE SEVEN.—"So-called history work, *i.e.* a reconstruction of social experiences, taken in its simplest (*i.e.* primitive) stages," helped by camping out and picnic experiences.

Shop Work.—Emphasis on constructive side, making of houses, tools needed—including hatchet and knife: all forms of wood, from the unfinished wood to the finished lumber.

Cooking.—More careful examination of cereals: comparison of weight and bulk by measuring. In the spring, the three types of vegetables, in each case working out the method of cooking as determined by the starch, woody fibre, or flavouring substances, such as minerals and oils.

Sewing.—Skins, fur, and their treatment. Primitive implements made in the "shop" and used to prepare wool, from fleece to finished cloth. Technical work in sewing—work-bags, wash cloths, woven on simple looms.

AVERAGE AGE EIGHT.—Study of American Indians "personating a tribe," "seeing what man has accomplished by a people before the use of iron was known." "This is the period, in increasing measure, of acquisition of skill, of technique"—in all subjects of the curriculum.

Shop Work.—A rude boat, sails. Making spindle and loom for the textile room. Design for an Indian mat; Indian basket for reeds. First principles of machines: use of joints, knife for whittling; making articles needed for history and science.

Cooking.—Typical form of proteids as found in egg, milk, and meat (as affected by heat, acid, and water).

Practical gardening commenced.

AVERAGE AGE NINE.—Local history and geography: Chicago and the north-west: finally, history of eastern colonies begun.

Textile Room.—"Development of the loom and weaving was studied—one of the children succeeded in inventing the heddle." Design for mats, for penwipers, etc. Dish cloths, holders, work-baskets for the use of the class. Much individual choice permitted to suit varying ability.

Shop Work.—Towel racks needed in the school. Model of a "prairie schooner": articles for gifts at Christmas. A typical pioneer colonial house, which involved the first principles of house construction in wood (gable, roof and strength of timber).

Cooking.—Vegetables as for nine years old (with whom they shared the luncheon). Bread making, also cheese.

Gardening continued.

AVERAGE AGE TWELVE.—Completion of studies of the American colonies, with a variety of work in languages (including Latin) and science which had no connection with handicraft.

"This group united with Group X. in some work for the club-house, both in manual-training periods and in art work, and discussions of principles of sanitation."

AVERAGE AGE THIRTEEN.—"The work of this group in the winter and spring furnished a concrete example of the possibility of correlating educational material through its relation to social experience. The organisation of a club among the older children, and the desire of a meeting-room of their own, together with the need for a dark room for photography, was the point of departure for work in household sanitation, architecture, interior decoration, carpentry and parliamentary law. The children decided that the erection of a club-house on the school grounds was a feasible plan; . . . chose the site, made the plan, estimated the cost, worked out a scheme of decoration, made designs for furniture, and did a considerable amount of construction of the little house." (The whole of this account on pp. 237, 238 of *The Elementary School Record*, final number, is most valuable.) The work in science—study of light and its applications to photography—also supplied experience in handicraft.

II. From *The Demonstration School Record, No. 2.—The Pursuits of the Fielden School* (Manchester University Press, 1913).—The curriculum of the Fielden School as published in this book gives no details as to handicrafts before the age of ten (Class III.) The younger children from the kindergarten up to Class II. have been allowed to work, more or less, on methods similar to those expounded by Professor Dewey, but with more emphasis on classical stories, Norse and the Greek.

Average age Ten (Class III.).—The Humanities syllabus covers Celtic and Roman Britain, the English Conquest up to the Norsemen and William the Conqueror in eight sections (local history and geography are taken along with these). Each of these topics affords handicraft problems in early pottery, paper modelling, simple wood work (saw, nails, and glue), coarse sewing, including decorative work and simple basketry. Illuminated lettering is taken with the handwriting.

As an example in detail, Section III. may be quoted: plan and model of Saxon farmsteads and Saxon ship. Model of early English village, houses, barns. Making of stage properties for a

slight play, illustrating the life of the early English, *e.g.* glee harps, drinking vessels, horns, weapons, byrnies. Simple tapestry on sacking, worked in coloured wools. Agricultural implements; food utensils in clay, wood, cardboard. Parts of a monastery, arches, doorways. Reed pens; monkish sandals (used in a play written by the children).

Average age Eleven (Class IV.).—The Humanities syllabus carries the children forward through the Middle Ages: the handicraft problems are of the same character as those of Class III., but more developed in form. "Writing, illuminating, and binding of chronicles of historical events: binding of other books are needed." Models of buildings which must involve as far as possible the actual limitations and difficulties of the builder.

Average age Twelve (Class V.).—In the Humanities syllabus the end of the Tudor period is reached and a rich variety of models is afforded, using the same materials as in the previous year, *e.g.* the use of the buttress in architecture becomes important. Wood and clay models in the solid, to help the science course are also made: the effects of baking the clay are also noted.

In co-operation with Class IV. "a large model of the earth in wooden frame-work and cardboard surface for use in the course of Physical Geography" has been attempted (globe about 2 feet in diameter).

Average age Thirteen (Class VI.).—Forward through the seventeenth century. In the craft room much time is taken to trace the development of printing: wooden types and a wooden printing press: setting up and printing of school notices: woodcuts of rough illustrations and decorations. This is followed by paper and bookbinding—quarto, folio, etc., studied practically.

The Elizabethan house, model of Greek and Roman order of architecture, with reference to the classical revival. "Models should be constructed not of cardboard, but in the same way as the originals."

Average age Fourteen (Class VII.).—The eighteenth century, concluding with the Industrial Revolution. Naturally the handicraft work is here concerned largely with the problems arising out of the applications of science to industry, reverting back to the work in spinning, weaving, etc., practised in earlier years.

"Construction of pulleys and other simple machines. The application of heat to industry in the working of metal."

Average age Fifteen (Class VIII.).—The curriculum both in the Humanities and Science is now directed to the study of modern conditions and problems, since the scholars are soon to leave school, the craft work follows suit. The boys of this class have taken a regular course in vegetable gardening while the girls gave the time to needlecraft. Also the printing press has been used extensively, and electrical and chemical apparatus for the science syllabus, including the installation of wireless telegraphy (official sanction having been secured).

The authors of the above syllabus do not undertake that all the details specified will be carried out in any one year. "The syllabus given is not intended to be treated as a series of exercises, but rather as group of suggestions concerning the type of work which will be a natural outcome of life's demands."

The following paragraph is added at the foot of the directions for the handicraft syllabus:

"*General for all Classes.*—Apart from the Humanities syllabus any piece of work about the school within the power of the scholars should be apportioned to the class best fitted for the work as such work arises. Examples are: Mounting and framing of small pictures, 'Passe-partout' work, making and repairing of chalk boxes and waste-paper boxes, decorative friezes for the class room, apparatus required for the science syllabus, making and binding of covers for books."

XXX. THE BASIS OF EXERCISES AND METHOD FOR JUNIOR PUPILS

By Miss Clotilde von Wyss

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The Function and Aim of Handwork for Junior Pupils.—The function of handwork in schools is, in the opinion of the writer, to provide activity for such physical organs as eye and hand, and to provide opportunity for observation, planning, and reflection. It thus ensures continual interrelation of ideas and action. From this consideration the special aim of the handwork in junior departments may be formulated. It does not lie in the mastery of tools nor in the production of beautiful and desirable articles; it cannot therefore technically be called "manual work." The aim of junior handwork lies within itself; it is to give the child intellectual responsibility for devising plans, material, and tools for his work, and to let him acquire wisdom by mistakes and by success, which is again capable of controlling further action when suitable stimuli present themselves. Thus fact becomes faculty.

Principles which control the Selection of Exercises.—It is impossible to lay too much emphasis upon the fact that the children cannot throw themselves heart and soul into their work unless they have a definite motive for doing it. The very nature of the work requires close attention, concentration, and independence of thinking which the stimulus of a clearly conceived motive alone can sustain. Might the motive be fear of punishment, hope of material gain, love of emulation? To induce children to work by an appeal to such emotions is a refuge for destitute teachers. No such artificial means are required if occupations are of interest to the child. The word "interest" is used in a wider sense, connoting not only pleasurable things,

but the normal mental attitude towards some possible experience. It therefore becomes a matter of paramount importance that the handwork has some definite relation to the range of the child's life, and that it is an outgrowth of his present tastes and tendencies.

If the child himself realises that some desirable achievement might be attained if he possessed some particular article, skill or knowledge, the right motive for efficient construction, sustained labour, toil, and grappling with subject-matter is established. The problem for the teacher, then, lies in this, that he so prepares conditions that the children, in virtue of their present tendencies, instinctively turn their own activities towards the fulfilment of their own human possibilities. Occupied in this way the children show signs of a growing self-respect and contentment. The satisfaction of constructing an object that adequately serves a given purpose develops into a delight of doing things well and making them beautiful.

The meaning of the above remarks will become clearer by reference to some definite instance, which may serve as illustration. In the course of events a class of little boys (age nine years) make the acquaintance of silk-worms just hatched from the eggs. To possess and rear silk-worms becomes the climax of desire. The possibility of owning some excites interest. The boys understand what are the necessities of life of silk-worms, and they appreciate the reasonableness of the reminder that they must offer some guarantee of their ability to care for them before taking possession. Ways and means are considered. The one and only obstacle is associated with the housing question. The boys' means are limited, and the buying of suitable cases out of the question, also match-boxes are inadequate and unsanitary.

Here, therefore, is a set of conditions closely related to the children's present tastes and experience, and containing one obstacle in the way of the fulfilment of desire. The latter stimulates the children to activity, but the conscious motive for constructing a breeding-case is the necessity of removing the obstacle in the way of providing for all the wants of their pets. The details of construction require much intellectual activity,

and learning by experience is an obvious feature of the work. A sense of satisfaction and enjoyment is evident, although the work contains elements in themselves disagreeable and difficult. In the gladness of their souls many boys wish to ornament their breeding-cases, testifying to the fact that art is born of joy in labour.

In selecting exercises in construction it will be found that they represent two classes, according to the special need which they are to supply. (1) Certain exercises lead to the construction of articles which in the opinion of the children have some interest or value of their own, and appertain therefore to the general categories of crafts and industries. Examples: weaving a hat-band, making a work-basket, binding a book, modelling a flower-vase. All these exercises have some æsthetic value, and arise from the children's love of useful and beautiful things. The children's motive is supplied by this need of things that seem to them good and beautiful. (2) Other exercises assist in some intellectual pursuit such as science, mathematics, or geography. Examples: Making of models to record the main facts of the structure of flowers; constructing a balance to be used in simple scientific work; inventing a special tool for some practical process; making a relief map.

Method of Instruction.—A general survey of handwork courses in junior departments in schools reveals several types of methods of instruction, which should be critically considered.

(*a*) In some courses it is obviously the teacher's aim that the children should construct carefully and well some particular object. The analysis of the process of construction is made by the teacher; the children often do not even see a model of the finished article. The work is dictated and directed step by step. This method involves hand and eye training—in fact the entire force is concentrated on the physical or manual side. It is generally adopted where education for a trade is aimed at, and the mastery of tools is of vital moment. But inasmuch as the child is in no way responsible for the process of construction, and is not required to exert himself intellectually, much less to make experiments with material or tool, the educational value of the process is entirely lost. Moreover, education for a trade

and purely technical training has no place in the early years of school life.

(*b*) In other handwork departments for young children the watchword of self-activity controls affairs. The children are supplied with some kind of material—*e.g.* cardboard, bundles of sticks and paste, or with match-boxes, sticks, and gum, or with bast and strips of wood, or with pieces of cloth, needle, and cotton. They are required to make with these materials any object they please. Some children with vivid imagination and a strong play instinct produce toys often very skilfully constructed. Many children are overwhelmed by the freedom of choice and the lack of stimulus in any one direction, and their work resolves itself into vague play. Yet another section of the community derives ideas from the leaders of the class and delights in doing the same thing.

Work of this kind seems to be based upon the fallacy that the child can think and work things out for himself without some factor in environment which will start and direct thought. Pure self-activity is impossible and all intellectual activity is dependent on environmental conditions, and it is futile to hope that anything but the crudest work can be carried out by the children, all of them invited to make things at a given moment with given materials and with vague and varied thoughts forming the mental background.

(*c*) It is not impossible to devise a method of instruction which will embody the most important elements of both the preceding forms of teaching, and this is desirable, since the adoption of one to the exclusion of the other is in each case the cause of failure. In accordance with the principle asserted in the early part of this article, every exercise in handwork must have its origin in an intellectual atmosphere in which the child becomes conscious of a real need and is filled with a desire to satisfy it. To create this situation is the function of the teacher, the responsibility of devising ways and means is the child's, and being responsible he must be free to select material and tool to carry out his own plans.

In a course of instruction of this type it is in no way intended to exclude technical training. But whereas it is generally con-

sidered sufficient that the teacher has a clear conception of the end in view for which it is necessary for the child to acquire certain skill and power, the considerations stated in the early part of this article require that the child is aware of his own end and feels his own need. Thus, in the course of building a toy cart the boy through experience realises the necessity of hammering a nail straight into a narrow strip of wood, he will therefore of his own accord, or at the mere suggestion of the teacher, practise hammering nails into a waste piece of wood.

Likewise in decorating the cart with a design in colour and chip carving he will practise both brush stroke and manipulation of knife patiently in order to acquire the necessary skill required for his handiwork. In all these instances the child himself realises the need and trains himself, often with a determination and perseverance that only a heart's desire can command. To induce the child to practise hammering in nails straight and make brushwork designs on paper because some day the skill thus acquired may come in useful, is a situation which has little significance to him, and because the motive is not part of his own mental attitude, perseverance is apt to flag.

The above represents an ideal method of procedure, and in schools where the classes are small and space and funds adequate this ideal can be realised. All the same no one is blind to the fact that with classes of thirty to fifty children the exigencies of space and other limitations require a clipping of wings. But never for a moment must the ideal be lost sight of, nor can the work be looked upon otherwise than *pro tem.* The general conception of the plan of work will still remain the same; the creation of a definite desire and motive is still possible. With the help of rough material the children can still work out their own plans and give expression to their ideas. It is probable, however, that they cannot all carry out their schemes, especially if very varied and costly material is required. Here a new phase in the lesson must be devised. All the plans of the children must be submitted to the criticism of the class, and the one which seems best by common consent is carried out.

Again in the case of the construction of articles which have excited the admiration of the children and have aroused their

love of imitation and possession. The children should each be provided with a model of this object, so that they might discover for themselves the plan of construction. This is obviously impossible where large numbers are concerned, and again some compromise between joint and individual action must be resorted to.

It seems unnecessary to emphasise that constructional work in which the teacher has carried out an essential part, cannot be called the child's work, and often implies a moral delusion. Thus, to let children in infant schools weave baskets of which the beginning and turning up of the spokes is the work of the teacher, cannot be looked upon as educational handwork, though it may mean employment and occupation.

Suggestions for a Scheme of Work.—Experimental work carried out in the demonstration schools of the London Day Training College resulted in the following scheme of work for the three lowest classes (age seven to nine respectively).:

Stage I.—(*a*) Stick laying to be developed into figure drawing in illustration of stories. (*b*) Clay modelling, chiefly in connection with a course of social history, for which beads, rings, pots, and exercises in building are required. (*c*) Colouring and cutting out paper figures made to stand, to be used in a realistic and dramatic representation of regions in geography, scenes in stories, etc. (*d*) Invention and construction of tools, implements, and utensils in connection with experience of primitive industrial processes.

Stage II.—(*a*) Clay modelling in connection with geography. (*b*) Simple models in stiff paper for the geometrical analysis of solid figures—*e.g.* match-box, cupboard, cottage. (*c*) Making a simple portfolio for collection of pressed leaves. (*d*) Strengthening and painting a wooden box to serve as window garden. (*e*) Decorating flower-pots with simple designs based on geometrical units. (*f*) Making a chip basket for growing mustard and cress. (*g*) Making a wooden loom and weaving with it. (*h*) Making toys—*e.g.* cart, woollen ball, etc.

Stage III.—(*a*) Making a portfolio for brushwork studies. (*b*) Bookbinding. (*c*) Construction of a fruit and seed chart with pictures "made to open." (*d*) Making mats and baskets

with chip-wood, raffia, or cane. (*e*) Lace making (girls only). (*f*) Making geographical relief models.

One of the chief features of such a course is the fact that the work is not restricted to any one kind of material, the selection of articles arising from the personal needs of the children and the needs of the more purely intellectual section of the curriculum. To confine activity to woodwork at one time, clay-modelling at another, and cardboard modelling at yet another, introduces an element of artificiality which is contrary to the fundamental principles of educational handwork. The characteristic feature of such handwork must be parallelism to the methods of real social life.

XXXI. SPECIMEN LESSONS ON HANDWORK

By Charles L. Binns

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Planning out a Lesson.—In giving a lesson on any subject the teacher must keep in mind the age of the children he is dealing with, the amount of knowledge they already have of the subject, and the time at his disposal for the purpose of the lesson. A study of child nature and the ways in which the mind works will help him to make his teaching suit the children's capacities; will help to give him more of that desirable "tact" in teaching which some maintain is a born quality rather than an acquired one. The children should take an active part in the lesson and be led to observe with exactness, to reason and form sound conclusions on what they see, and to rely as much as possible on their own powers of acquiring knowledge. Observation is more than mere seeing; the full appreciation of what is seen depends upon the contents of the mind and the interests of the person seeing. Hence the teacher must guard against the tendency to assume that his hearers see and think in exactly the ways he himself does; he must bridge the gulf of years and try to see as the children see.

Questioning plays such an important part in all forms of instruction that the teacher should give careful study to the art. The three chief types of questions may be classed as preliminary or experimental, instructive, and examinatory. The first is used for finding out what the pupils already know relating to the proposed lesson, the second to direct the course of the lesson as planned in the teacher's mind, and the third for testing whether the lesson has been properly apperceived. In instructive questioning more time should be allowed for thinking out the answer than is needed for the other forms.

A good question should be clear and concise, worded in language suited to the vocabulary of the children, and definite enough to admit of only one right answer. Questions requiring *Yes* or *No* for answer are apt to encourage guessing and should be used very sparingly. The answers of the children should, as a rule, be in complete sentences, but this ought not to be carried to the point of pedantry; they must be grammatical, to the point, in the children's own words, and should show that thought has been given to them.

Nothing in the writer's opinion will so greatly help in planning and giving lessons as a thorough understanding of the Herbartian Formal Steps. Psychologically, the method of Herbart and his followers may be open to certain objections, but it offers the best scheme of practical teaching principles available to teachers. Briefly put, the purpose of the five steps is as follows:

(1) *Preparation.*—This is the preparation of the children's minds for the lesson, by finding out what is known relating to the proposed lesson and bringing into activity the pupils' ideas germane to the subject. State clearly the aim of the lesson, do not leave it to be guessed. Ask yourself, What do my pupils know, and what ought they to know in order to understand?

(2) *Presentation.*—Having created an appetite for the new matter, the next step is to satisfy it; not by a glut of food with no time for assimilation, but in mouthfuls as it were, with proper time for chewing and swallowing. In other words the connection between the separate parts of the lesson and the lesson as a whole must be ensured by first concentrating attention on the details and then reflecting on their bearing—an ebb and flow from part to whole.

(3) *Comparison.*—After calling up ideas likely to help and then adding the new matter, the next stage is to compare and contrast. Idea after idea, like brick after brick, having been laid, they must now be bonded horizontally. Examples, objects, illustrations, etc., aid in this.

(4) *Generalisation.*—Here we form general conclusions, make our "law," fix a definition, or draw our moral.

(5) *Application.*—Now comes a test which enables the teacher to discover whether the lesson is a success or not. Intellectually,

the lesson finishes with the fourth step, but knowledge is more fully our own when it serves as a basis for action. Let the test be as practical as possible.

Lesson I—The Saw

Step 1. *Preparation.*—Have you all used a saw? Tell me what kind of a saw you have used? Do you know of any other kinds of saws?

Aim of the Lesson.—To find out in what ways the saw does its work better and more easily than any other tool will do it.

Step 2. *Presentation.*—Now we can, perhaps, best discover the special value of the saw as a tool if we imagine that we have all other tools at our disposal, but no saw. We will suppose, then, that we are all cast ashore on a Robinson Crusoe island with plenty of other tools, but without a saw, and that we have saved plenty of timber—planks, boards, etc.—from the wreck. By the way, how were these boards cut? If our stock of them runs out, how shall we make our own boards from the trees we have about us?

We shall, of course, need to make many things. Suppose we desire to cut this board I have here into two equal lengths, how shall we set about it? Various suggestions are offered:—Break it; cut vee-shaped grooves across it on both sides; bore a row of holes across it, and so on. Shall we get true ends to the board? Shall we be able to get our two pieces as long as we could if we had a saw? We want to cut the pieces next, we will suppose, right along the centre into two narrower boards; how can that be managed? Split it with an axe, or by means of wedges. Will it split just where we want it, or how will it split? No, it will split with the grain, and that is not always parallel with the edge of the board.

Ask questions on slanting cuts in the same way, and draw out the fact that all the severed edges would need trueing with axe, or chisel and plane.

It will be noticed that the pupils are required to think out for themselves how the problems and situations presented by the teacher can be satisfactorily solved. Most boys have faced the analogous situation of severing a piece of string without the use of a knife or other cutting tool. Should the teacher prefer

it, however, he may proceed experimentally. The problem is a suitable one for the Heuristic method, and the class might be told off in small groups to carry out practically the different cuts without using a saw.

Step 3. *Comparison.* Can we do the work in less time with a saw? with less labour? with less waste? and better for our purpose?

Step 4. *Generalisation.*—We started out to find why the saw does its own particular work better than it can be done with other tools. Now I want you to give me a definition of what the saw is. A tool with teeth. Yes, but so is a comb, or a rake, or a cog wheel. I want your definition to say what the saw does, and how it does it compared with the way other tools would do it. Various definitions given and discussed.

A definition to embody the matter of the lesson would be: A saw is a tool with teeth used for dividing timber in any direction with the least amount of effort and the least possible waste.

Step 5. *Application of Lesson.*—A class engaged in woodworking makes practical application of the lesson in using saws with a better appreciation of their efficiency. Another application would be to sketch a saw and write under it the definition of a saw arrived at during the lesson.

Three or four boys might each try one of the different ways mentioned of cutting a board, and report as to the time taken compared with the same task carried out with the help of the saw.

Lesson II—How the Saw Acts

The above lesson, drafted out on the lines of Herbart's Formal Steps, deals with the efficiency of the saw as a tool; it takes no account of the cutting action of the saw, that is, *why* it acts so efficiently. If one lesson only has to be given on saws, the above treatment is, perhaps, as suitable as any. If a series of lessons is contemplated, the first three steps might well be all included under preparation. It seems desirable to emphasise this, so that it may be clearly understood that the Formal Steps can be spread over several lessons, instead of being applied to each separate lesson.

If Notes of Lessons are solely for the teacher's own use, and he

is thoroughly familiar with the ground to be covered, the following outline is all that is necessary for the purpose of further instruction on saws. *The Shape of the Saw.*—Get pupils to contrast shape with that of Chinese and Japanese saws; tension and compression; the advantage of pushing the saw instead of pulling it. *Thick v. Thin Blade.*—Which is the better? Contrast Eastern and Western types; limit of thinness of blade fixed by the need of sufficient stiffness to prevent undue bending when under thrust; this is obtained by the shape of the saw as well as by the thickness of blade. *Need of Clearance.*—Call attention to the cutting part of saw; "set" of the saw; reason for this; amount needed; methods of setting. *The Cutting Action of Saws.*—Get pupils to point out differences in the shape and number of teeth per inch in ripping and cross-cut saws. In ripping saws the teeth act like narrow chisels, severing the wood in slices; teeth are sharpened, therefore, by filing square across. Cross-cuts are sharpened obliquely, making a cutting edge on the outer edge of each alternate tooth; the wood is severed on each side of the cut, and the waste – the sawdust – pushed out by the thrust of the saw.

Questions are sure to be asked about the small "nib" on the back edge of the point of the saw. This projecting piece serves no useful purpose, but merely relieves the straight outline of the back edge. Sometimes it is omitted.

Lesson III—The Bow Saw

Pupils to recall that in our talk on saws we found that a thin blade is best, provided it be not too thin. Then by simple experiments and demonstrations the following points will be worked out. What is it that limits the thinness of the blade? Methods of stiffening the blade of the bow saw; twisted cord; long, fine bolt and thumb-screw. Show the pull exerted by the cord by using a spring balance or by loading. Say the pull is 30 lb., and that the distance of the cord from the cross stay and from the cross stay to the saw blade is as 2 : 3. Show by demonstration of the principle of leverage that the tension on the saw blade is 20 lb., and that this force is pushing against the handles and so exerts a pull on the blade. What is the

amount of the force acting on the cross stay in the middle? Fifty pounds. Is it a pushing or a pulling force? Could we exert a pushing or compressive force on the blade? Show what happens when a slight push of this kind is applied to a loose unsupported blade.

What pressure can be put on the saw without overcoming the tension set up by the twisted cord? If the latter is slackened a little, what difference will result? What occurs when the saw sticks and the blade is only slightly stretched? When is the saw blade most likely to break? What would happen if we kept twisting the cord?

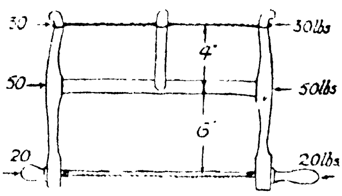


FIG. 1

Ask for definitions of tension and compression. What other examples of tension and compression can you give? Is the bow saw suitable for straight sawing? Why not? How could it be made suitable? Is the total pull on the blade 20 or 40 lb., seeing that the reaction is 20 lb. at each end? Show that one pull resists the other and that the total force acting on the blade is 20 lb. only. Hang a 20 lb. weight on the spring balance. What tension is there on the spring? What takes the pull at the end opposite the weight?

LESSON IV—THE DENSITY OF DIFFERENT WOODS

Specific Gravity.—Prepare specimens of the different woods by planing them to any convenient section. They need not necessarily all be alike, so long as they are of the same section throughout their lengths. For the purpose of this lesson we will assume that all the pieces are one inch square, and are cut off exactly ten inches long.

Step 1. *Preparation.*—We have here several pieces of different sorts of wood all planed up to the same size. One of you shut your eyes and I will hand you first one piece and then another, and you will tell me what you notice most. Their weights differ. Now you know that different substances contain different quantities of matter, bulk for bulk; you have an example of this in the specimens before you. How can we

compare them one with another in this respect? Yes, we *could weigh them* and so compare them one with another. It will be much better, however, if we have for our standard of comparison a standard that does not vary. I shall let you carry out the experiment I am about to show you in groups of three or four, and then we will have a further talk about the results.

Aim of Lesson.—We desire to find the density of these different woods.

Step 2. Presentation.—Here is a bucket of water; I lower this piece of yellow deal vertically into the water till the water just supports it. One of you come and measure the part that has been submerged. It is exactly 5½ in. We will now try this piece of walnut. It sinks lower than the yellow deal did; in fact, 7⅜ in. have been under water.

Now try all the specimens, and write down the results. Use decimals for the fractions.

Step 3. Comparison.—I see from your table of results that the piece of white deal, or spruce fir, is marked 5 in. What is the weight of the water that the wood has pushed aside, or displaced? Yes, it is exactly the weight of the whole piece of wood. (This is not an easy conception for boys, as a rule, and should be elaborated.) We know now, then, that white deal is just half the weight of a similar bulk of water; that is, a column of water 10 in. × 1 in. × 1 in. weighs double our piece of deal of the same size. If we take the water as our standard and call it 1, what figure will represent the white deal? Yes, ·5. That fraction denotes what is termed its specific gravity.

I have here, however, another piece of wood called lignum vitæ which we will try. It does not float at all, but sinks like a piece of iron. What must be its specific gravity? Yes, it is greater than 1, and we will try to find out how much greater. There is another way of doing this; but let us see if we cannot manage by the method we have used already. Suppose we try the result of fastening with two very light brads a piece of the white deal on one side, and another on the opposite side of the heavy specimen. Trying this next in the water, we see that the combined pieces sink to a depth of 7½ in. How much deeper

in the water is each piece of deal? $2\frac{1}{2}$ in, making 5 in. altogether for the two. To what is the extra sinking due? We may add the 5 in. to the reading of $7\frac{1}{2}$ in. then. What do you make out is the specific gravity of the lignum vitæ? (Sketch the arrangement on the blackboard as an aid). It is 1·25.

Step 4. *Generalisation.*—How do you account for the fact that some woods are heavier than others? Let us see the effect of placing these lumps of cinder and pumice stone in water. Tell me what has happened. Next we will take some of the lumps and pound them small. The powdered pieces now sink. Why is this? Yes, you are quite right; the larger pieces are full of holes, and it is the air imprisoned in these spaces that keeps them afloat. Broken up small they are much less in bulk, the same amount of matter takes up less space; in other words they are denser, more dense than water, hence they sink. Perhaps this gives you a hint as to why these different woods have different specific gravities. Yes, they too have air imprisoned in the minute tubes or fibres of which the wood is made up; as a matter of fact the actual wood material has a greater specific gravity than water. No doubt you can now tell me why some timbers are heavier than others? Observe the specific gravity of those woods you know to be the hardest of those in your list.

For greater exactness the water we take as the standard has to be of a certain temperature and pressure. Why is a temperature of, say, 62 degrees fixed? Is there a difference of density between hot and cold water?

The specific gravity of a liquid or solid is its weight in proportion to the weight of the same volume of water at a known temperature and pressure. The story of Archimedes and the golden crown, and the discovery of the method of finding the specific gravity or relative density could be told.

Step 5. *Application.*—Write a definition of specific gravity. The weight of a cubic foot of water is $62\frac{1}{2}$ lb.; find the weight per cubic foot of the timbers on your list. What weight is a cubic foot of cast iron? Its specific gravity is 7·21.

Lesson V—The Hardening and Tempering of Steel

Preparation.—Who knows what most of the tools you use are made of? Are they all equally hard or tempered alike. Our lesson will make you understand clearly what is meant by hardening steel and tempering steel. What is meant by hardness? Do you know of anything made of very hard steel? Will it bend? Mention something of steel which will bend. Is that as hard? Get some pupils to file first at the bevel of a chisel, and then a piece of broken bow-saw blade.

Presentation.—I have here a piece of broken clock-spring. I want you to watch closely what I am about to do with it. The teacher places one end of the steel in the hottest part of the gas flame, the top of the blue-coloured part of the flame, and when it is heated to a bright red, plunges it quickly into a vessel of water. Tell me what I did, and what you think has happened to the steel. One of you try to bend the end of it. What happens? Yes, it breaks off as soon as you try. What do you say of things that are hard and break off in that way if you attempt to bend them? Give me examples of brittle objects.

The process you have just witnessed is called hardening steel. I will put the hardened end into the flame and heat it again, but this time I shall withdraw it gradually and allow it to cool very slowly. Now try to bend it. We find it bends and re-bends easily without breaking. The steel in this condition is termed soft. Before, it was hard and brittle; now it is extremely bendable and,—what is the word I want?

For most tools we need something between these extremes of very hard and very soft steel. By a process called tempering we can make steel any degree of hardness between very hard and very soft that we desire. I will harden the steel again, rub it bright with emery cloth—a piece of sandstone would do—and place it in the flame once more. What do you notice on the part just outside the gas flame? What do you think causes these colours to appear? They are due to a thin film of oxide forming on the clean surface of the metal, and the colours are a useful guide to the tool-smith in getting the right temper for any tool. Follow carefully what I am about to say and you will understand how this is done.

Suppose this block of iron to be red hot. This smaller piece of hardened steel, rubbed bright, is placed on it. What effect would the hot iron have on the cold piece of steel? By the time the steel is at a temperature of about 220° C. a pale yellow colour would show, at 230° C. a light straw colour, and as the steel gets hotter we should see in succession dark straw, brownish yellow, brown, purple, bright blue, deep blue, and finally the steel would go black before entering the red hot stage. If we want to "let down" or temper a piece of hardened steel for a tool, we must cool it off by plunging it in water when it has reached the colour which represents the right degree of hardness for the kind of work the tool has to do. All this should be demonstrated by actual experiments and observations, wherever possible.

Think first of the work these tools have to perform, and then tell me which should be the harder, a chisel or a screwdriver? Yes, the chisel is the harder of the two. What would happen if you were foolish enough to use a chisel to drive in screws? It is clear then a screwdriver should be tempered to stand rough usage. If a saw blade would not bend, what would occur? Is that as hard as a chisel? Let us get back to those colours: I will write them down in the order in which they appear and tell you the colours that give the proper temper for several tools. For instance, the pale yellow is right for files and lancets, where great hardness is required; brownish yellow is suitable for penknives, punches, chisels, etc.; brown for scissors and plane irons; purple for axes, which have to strike heavy blows; blue for springs, saws, and screwdrivers, which must all be tough and elastic.

Comparison and Generalisation.—Can any piece of steel be tempered? No, for many purposes what is called mild steel is used, for example railway and tram lines, the plates of which steam boilers and ships are constructed. Why cannot this sort of steel be tempered? The reason is because it contains only a small amount of carbon. It is almost the same in fact as ordinary wrought iron (which is nearly free from carbon), except for its greater hardness. Unless there is sufficient carbon in the steel it will not temper. Tool steel contains only 1 per cent. to 1·5 per cent., but even this small quantity makes a big difference to its nature.

I wonder if you have ever thought how much we owe to those early workers who first found out how to work metals into tools and weapons. What were the earliest tools made of, the kind that primitive man used? And what followed flint? No, another metal came into use before iron, and that was bronze. Bronze is a mixture of nine parts copper and one of tin. So important have these materials been in the history of man that the three great periods of history, going back thousands of years, have been called the Stone Age, the Bronze Age, and the Iron Age. Steel is only a better kind of iron. What is iron made from?

Application.—It has been assumed throughout this lesson that only the simplest experiments are available. The boys may be asked to carry out such tests as the following: See if a piece of corset-steel will temper. Try to harden a wire nail. Make a nail punch from a piece of steel wire. Should the end of the punch struck by the hammer be hard? Why not? Find out if the tang of a chisel is as hard as the blade.

Notes on Practical Woodwork Problems

Three typical examples, suitable in this case for the elder scholars, will show how some of the practical work may be carried out.

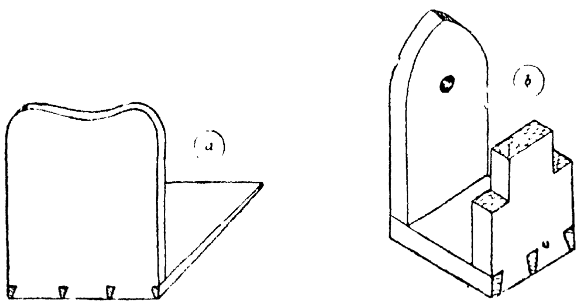


FIG. 2

We will suppose it is desired to introduce the common dovetail joint. The two sketches (*a*) and (*b*) are drawn on

the blackboard and the boys allowed to select either one or the other.

In the case of the book support, which is to support the end books of a partially filled bookshelf, the width may be marked 4 to 5 in. and the thickness $\frac{3}{8}$ in., leaving the design to the scholars' choice.

For the match-box bracket, stipulate that the projection on top of the front piece be $1\frac{3}{8}$ in. by $\frac{5}{8}$ in., the size of the opening in an ordinary match-box. The design and the general proportions may then be left to the scholars. All the demonstrations necessary for pupils of this stage would be the joint. Show the class a well-designed dovetailed joint, and get them to compare the proportions of the pins. Then mark out and make one joint in front of the class. As soon as the first pupil is ready, the method of glueing up the joint should be shown. In the case of the book support the horizontal piece should be thinned down at the end before the two pieces are glued together. The trimming and smoothing up of the joint must not be attempted, of course, till the glue is thoroughly set.

This lesson might well be followed by a more difficult problem embodying the dovetail construction just practised. The example below makes a demand on the pupils' intelligence apart from purely manipulative ability. Write on the blackboard:—
A sovereign measures approximately $\frac{7}{8}$ in. diameter and $\frac{1}{16}$ in. thick. You are to make a dovetailed box that will just hold two thousand sovereigns; the top and bottom of the box to project $\frac{3}{8}$ in. on each edge, and the thickness throughout to be $\frac{3}{8}$ in. Give thought not only to the correct size of the box, but also to the pleasing proportions that should exist in relation to length, breadth, and depth.

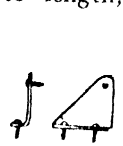


FIG. 3

The task should be left to the scholars to work out entirely by themselves. When all have completed the box, attention may be called to those showing the best proportions. The designing and making of a pair of suitable hinges from stout tin or sheet brass would form a further exercise. The boxes when finished could be taken into the art room and, under the supervision of the art master, designs be got out for a simple incised

carving pattern for the top of the box, or a *painted* or *stencilled* decoration. The box illustrated is a boy's work, but not the design of the stencil.

BOOKS FOR REFERENCE

Suggestions for Teachers, issued by the Board of Education; JOHN ADAMS' *Primer on Teaching* (Clark & Co.), written for Sunday-school teachers, but a capital book for all teachers; JOHN ADAMS' *Herbartian Psychology* (Heath & Co.); JOHN ADAMS' *Exposition and Illustration in Teaching* (Macmillan); J. J. FINDLAY'S *Principles of Class Teaching* (Macmillan); and for subject matter BINNS & MARSDEN'S *Principles of Educational Woodwork* (Dent & Sons).

XXXII. PAPER MODELLING FOR INFANTS

By Miss Lilian E. Brown, B.A.

Mistress of Method at the Training College, Swansea

The Value of Paper Modelling in the Infant School.—Paper modelling may be regarded for many reasons as one of the most valuable forms of handwork for infant schools. In the first place *it is an occupation which gives real pleasure to the children*; the keenness and interest of a class of children engaged in this occupation is a strong plea in favour of its inclusion in the curriculum. The reason for this pleasure in the work is that scope is allowed for that constructive instinct which is so strong in all children, and for that love of activity and of investigation which is so frequently stigmatised as "destructiveness," but which, when given a legitimate outlet in such a form of handwork as paper modelling, is a good quality, and one which assists considerably in the child's development.

Besides being a pleasurable form of occupation for the children, paper modelling is at the same time a valuable means of education. *It leads to brain development* in the same way as do all forms of handwork, because it necessitates thought and ingenuity on the part of the child in planning out how to make the desired object, how best to use available material and so on. Properly conducted, it allows scope for expression and self-activity in a very marked degree. Those people who advocate early teaching of number for "training intelligence," would, if they could only realise it, achieve far better results by means of paper modelling. Moreover, in the course of this work the child gains incidentally and by experience some useful knowledge with regard to facts of number, ideas of form and size, and realises the meaning and value of measurement. It thus forms an interesting practical introduction to the teaching of number and elementary geometry.

Paper modelling admits of easy correlation with the child's experience and with other lessons. Many things in the child's environment both at home and in school can be reproduced in paper, and it lends itself admirably to illustration of stories. Thus the work is interesting to the children and adds to the interest of other lessons.

All forms of handwork taken in schools should be capable of development, that is, there should be a possibility of progress and continuity in the handwork done by the child at different stages. One form should lead on to another; it is a mistake to spend time on work which leads nowhere. Many of the so-called "Kindergarten Occupations" of the past transgressed this rule. A child spent the weekly lesson for a year on mat-weaving, and the next year on paper-folding; the one did not materially help the other, and neither of them was developed in any form of handwork when the child moved into the upper school. *In the case of paper modelling there is careful progression and natural connection* between the simplest work done by little ones in the infant school, the more difficult work done by the oldest infants, the cardboard work of the standards, and woodwork and metalwork of the eldest scholars, and, moreover, the knowledge and skill required may be of practical utility in everyday life.

If the school life is to be *connected with the home life of the child* we need such occupations in the school as can equally well be carried on in the home. This debars us from taking handwork which requires costly or elaborate apparatus. Such work would be regarded by the child as "special" and only meant to be carried on in the school. Materials for paper modelling—paper, scissors, and paste or pins—are cheap, and obtainable in every home, and so the work of the school can be the pastime of the home, thus helping teachers in their efforts to lessen the gulf between the two. Moreover, because of the cheapness of the materials, teachers can afford to let children experiment, originate, and express themselves quite freely.

Handwork is not taught now, as in former days, chiefly with the view of *making children dexterous.* Nevertheless this must not altogether be despised. The care and accuracy required in folding and cutting paper, and the neatness and deftness required

in fixing the models, is not entirely valueless, but must be extremely useful to the child throughout his life.

Underlying Principles guiding Choice and Methods of Work. *The objects made must be such as will interest the child*, and the work should arise out of his desire to make them. If the objects made are not interesting to children, and are made at the order of the teacher because they "come next in the course," the work loses its chief value. A skilful teacher may succeed in inspiring the children with the desire to make the object "next in the course," but without this inspiration nothing but dulness can ensue. Most children will be interested in making toys, in reproducing objects they see around them at home, in illustrating stories, and in making things useful to themselves or suitable to give as presents to others. From such objects as these should the teacher choose her models, when they are not the natural outcome of the work of the day.

At this stage, the object to be made is the main consideration in the child's mind. When a child conceives a desire he wishes to carry it out at once. *Too great stress must not, then, be laid on technical skill and accuracy.* The child's mind and fingers are incapable of dealing with minute things. The old type of paper-folding demanded far too much accuracy of detail, and in so doing, often destroyed the child's interest in the purpose he had in view; in fact, in many cases, so engrossed was the teacher in training skill and encouraging accuracy that the children were not even told what they were making, and often many lessons elapsed before anything resembling an object was produced. The objects then for young children should be simple. In the early stages as a rule the model should be finished at one sitting.

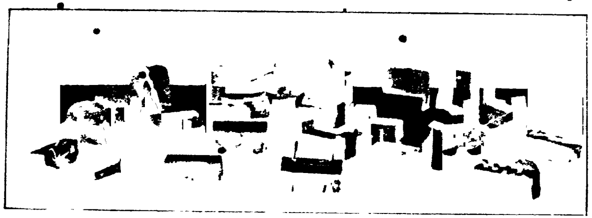
Throughout the work the child must be self-active, that is, he must not only be working with his hands, must not only know what he is to make, but must take a very good part in finding out how to make it. Lessons based on mere imitation do not comply with this law. Teachers often advocate relying on mere imitation in the early stages, but this is quite unnecessary. The child should be encouraged to think, and to investigate from the first, or he will never originate, discover, and invent for himself later. Mere imitation kills inventiveness. A top class of infants trained

from the beginning to think, discover, and work independently will often show more originality than the average grown-up person, while a class not so trained will be helpless when confronted with the request that they should make some new object without the help of the teacher's instructions.

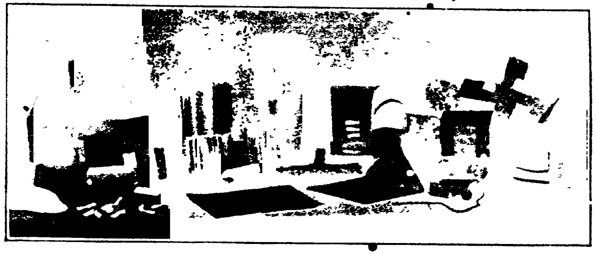
Methods of Conducting the Lessons.—As far as possible *the work should be original and independent* if the real value of it is to be obtained by the children. Much of the modelling done in schools now is not real constructive work; it is based on special "ground forms" and involves "tricky manipulation" of the paper rather than thoughtful consideration of aims and methods on the part of the children. When the model to be made has been selected the children should be allowed to make it each in his own way. Quick, rough work showing intelligence and individuality is preferable to careful work where every model is the same and the individuality of the child has played no part.

The time for the teacher to step in is when the children acknowledge their need for her guidance. At the end of the time those children (and a certain number of these will be found in every class) who lack initiative and have made unsatisfactory attempts may be assisted by examination of some of the best models or of one made by the teacher, as described later. Occasionally in paper modelling as in other free expression work, children may be allowed to make anything they like. This gives scope for originality, without discouraging the less inventive ones, who have the satisfaction of producing something, even though it is a model they have already made before.

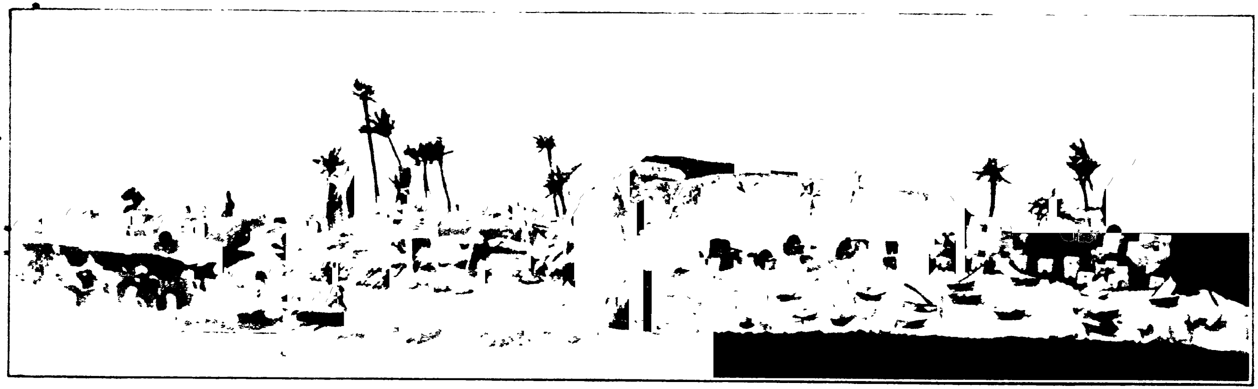
It will be found, however, that constructive work in paper is at first a difficulty to children, who cannot at present see in the solid model the flat paper nor image from the flat paper the finished model, and it will therefore be found necessary for some models to be made by the whole class with the assistance of the teacher. This must not be taken to mean that the children take no part in planning out the work. *The most usual type of lesson* in this case will be that in which a finished model, made previously by the teacher and pinned together, is taken to pieces and examined, the children thus finding out how it was made. From the flat paper they can easily discover what folds and what



(A) GROUP OF PAPER MODELS—INDEPENDENT WORK DEVELOPMENT FROM OBLONG BOX



(B) GROUP OF PAPER MODELS—FREE WORK BY CHILDREN OF SIX



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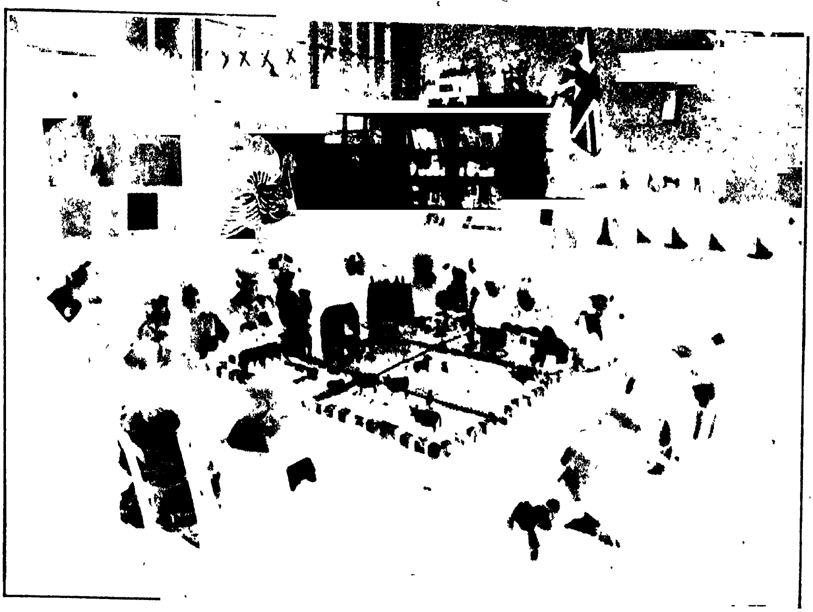
CLASS OF SIX-YEAR-OLD CHILDREN AT INDEPENDENT WORK ("DO WHAT YOU LIKE")



GROUP WORK. CHILDREN SIX TO SEVEN YEARS OF AGE MAKING MODEL OF A FARMYARD

cuts to make; the teacher will guide with a question or suggestion if necessary. Even in this type of lesson the children must not be forced to work step by step with the teacher. Nothing is more irritating to a child who sees the way for himself than to be kept waiting till the whole class is ready for the next step; and this is the sole reason why some teachers experience difficulty with "discipline" in handwork lessons. This method of discovery should be adopted from the earliest lessons if these are to help the child with his independent work.

Even in these guided lessons originality should be encouraged wherever possible. For instance, the "finish" and ornamentation of a model made by all the children should be left to the taste of individuals. And here comes the teacher's opportunity for *incidental æsthetic training*. Without condemning the child's production, she can discourage over-ornamentation and any decoration which would detract from the strength or utility of the object. The idea of *beauty as fitness* should be encouraged from the beginning. A box or tray intended to hold small things is not ornamented, but spoilt, by addition of holes cut to form a pattern, and the children will easily be led to see this by a reminder of the purpose of the object.

Another way of encouraging invention in such a lesson is by letting the children add to the form made by the whole class and convert it into anything they like. An example of this kind of work is seen on Plate I. (*a*) shows original rough work (made in scrap paper and simply pinned together) done by children of six to seven years. An oblong box was made by all children working with the teacher. Then each child had an extra piece of paper and was allowed to turn the box into anything he liked. Among their productions are a week-end basket, a grandfather clock, sentry-box (with sentry man), a railway carriage, engine, a house, a house with garden, a cradle, an Eastern sheep-fold, a sideboard, washstand, etc., etc.

Methods to be avoided are all those in which the children work in the dark as to what they are doing and why they are doing it. The former type has already been mentioned above. A teacher tried to improve on that by telling the children what they were doing. A child in the class could therefore tell a visitor

what he was making, but when asked *how* the chair was to be made the reply came: "Teacher hasn't told us yet." An example like this speaks for itself. Again, lessons should never be taken in which the children simply imitate step by step their teacher's operations of folding, cutting, and making up, nor in which they simply follow the teacher's dictated instructions.

Group Work in Paper Modelling, and Correlation with other Lessons.—Paper modelling lends itself admirably, in conjunction with other forms of handwork, to group work in making large models to illustrate stories, etc. This type of work should be very largely practised. It gives admirable social training to the children, when each is doing his share towards one big thing instead of working merely for himself. Moreover, it is more interesting to make a large scene illustrating a story, than to make merely an object; and the work is full of suggestion and stimulus to the less original children, who gain in keenness and independence from the example of others.

This work may be organised in different ways. Sometimes several "lessons" may be spent in preparing different objects for the model. In this case all the children may make the same object, and a few of the best be used. This will encourage individuality and also the gradual development of skill, accuracy, and neatness in work.

At other times different groups of children or individuals will make the different objects necessary for the whole model. In both cases, of course, the scene to be made will be discussed by all and the necessary articles decided on, and when these are complete the work of building up the scene should be shared and discussed by all.

An interesting feature of this group work, and indeed of all children's free expression work, is their lack of idea of relative proportion, objects which to them are interesting being made correspondingly large, so that different parts of the same model are often quite incongruous in size. With very young children this may be allowed to pass for a time, but the teacher should gradually strive to get improvement, not by finding fault with the children's work, but by leading them to get better ideas and therefore wish to improve the work for themselves. It only

needs a little suggestion to make a child realise, for instance, that the man for whom the house is built cannot possibly get inside it; and after that it will be the child who desires to alter matters.

The illustration (*c*) on Plate I. shows a large model made by children of six to seven years in connection with a series of Bible stories. The work consists largely of paper modelling and furnished employment for many children. The scene represents on the left the country outside Damascus and on the right the Sea of Galilee. Very good models of Eastern houses of all sizes and varieties are made in paper (the domes, however, are inverted egg-shells), also bridges, tents, trees, ships, and (on the hill) an Eastern sheep-fold.

Most stories lend themselves to this type of illustration. Geography stories of children in other lands, such as Japan, Holland, etc., may be made living to the children by making models of town scenes in these countries. Simple stories such as Red Riding Hood, Cinderella, and many others necessitate a house, or a room, and suitable pieces of furniture, all of which can easily be made in paper. A farmyard scene, the basis of many nursery talks and stories, can be easily built up and furnished with sheds, barns, pig-styes, fowl-pens, carts, and all the necessary equipment, to which will be added a more living touch by means of small clay or plasticine models of the different inhabitants. Paper models which it is desirable to keep, such as furniture for a doll's house, may be made more durable and also more realistic by coating with a preparation of wood stain and varnish.

Grading of the Work—Suggestions for Useful Models.—It will be understood from what has been previously said, that to work in accordance with any graded scheme is not advisable; nor need the teacher confine the work to any set ground forms. The choice of work should be governed by the interests of the time, and the children should as far as possible be left to work out their own methods. When this is done children frequently show a degree of ability far greater than that with which the graded course credits them. At the same time, however, the teacher should bear in mind the idea of grading and progress so that she does not demand too much from beginners, and encour-

ages a gradual increase in constructive ability. This she may do by sometimes showing the children a model of more difficult and *more appropriate construction than their own* and so inspiring them with the desire to work in the better way.

When first the children start paper modelling, at about five to six years of age, very simple and quick work can be done, illustrating talks and stories, by making models such as houses, tents, screens, tables, benches, etc., which can be made by simple folding only, without any cutting or fixing. These will be only temporary in character, and from their simplicity will require the exercise of imagination with which the children are often more generously endowed than the teacher. This work will serve to make children familiar with the material, whilst giving pleasure as an easy form of constructive work; they will also gain ideas of form in dealing with the square and oblong paper, and will discover practically, even though they do not formulate in words, the value of "half," "quarter," etc.

Use of the Ground Form.—At this stage the teacher may find it advisable to introduce the conventional "16-square ground form." This should not be used to nearly the extent suggested in many courses of work. A few of the simpler models are very useful, but most of the more elaborate ones could be developed from these by the children themselves by *adding the necessary portions*, rather than by elaborate manipulation of the ground form.

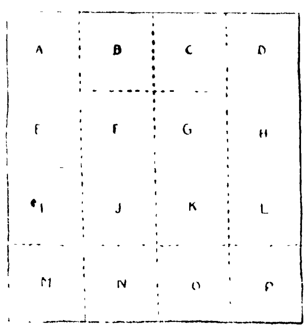


Fig. 1.

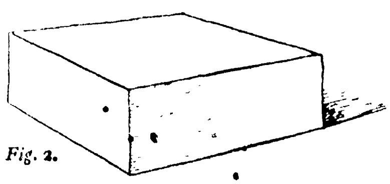


Fig. 2.

The *square box* (see Figs. 1 and 2) is simple and useful. From it may be made a basket (by adding handle), a table (by inverting, and cutting away to leave legs), Eastern houses, such as seen in Plate I. (*c*), carts (by adding wheels and shafts), and numerous objects which the ingenuity of children and

teacher will devise. A lid can be made by making a precisely similar box from a slightly larger square of paper.

An oblong box, which will form the basis of many useful articles, especially of furniture, may be made in the same way after cutting off a strip one square wide from one side of the paper. From this, with a little thought, may be developed a bed, washstand, dressing-table, sideboard, couch, piano, table, settee, houses and other buildings and numerous other objects.

A box with lid made all in one piece can also be constructed from the same form. This may, by altering the form of the lid a little, be used as a hanging box (soap, salt box, etc.), or a tidy.

To make square box.—Cut lines dividing each of the pairs of squares AB; CD; MN; OP. Paste square A inside B; D inside C; M inside N; and P inside O. *To make oblong box with lid.*—Cut away squares A and D; and lines dividing H and L, L and P, E and I, I and M. Paste H and P inside L, E and M inside I, leaving BC for lid.

A very useful model which can often be used in illustrating stories is the house (see Fig. 3). To make house use above ground form. Cut lines dividing squares A and E, E and I, I and M, and corresponding ones on opposite side. Paste square E on I. M and A are pasted over lower half of diamond, thus formed, to form side of house, M slightly overlapping A. Form opposite side in same way. Windows, chimneys, and doors can be cut as the children wish before finally fixing the model. The same model, with alterations, will serve for a church, school, barn, shed, haystack, dog kennel, and other objects.

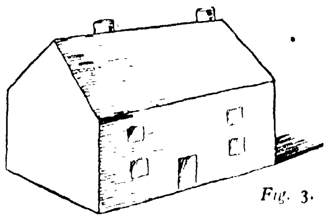


Fig. 3.

During the course of this work the children gain practical knowledge of number; incidental reference may be made to number, *i.e.* the analysis of sixteen is well illustrated and also the idea of halves, quarters, eighths, etc., in fact the children would probably gain more real knowledge of number from a lesson spent on modelling than from many a so-called number lesson.

The square divided into nine smaller squares is not nearly so useful as the previous form, and need not necessarily be used, since it could, if desired, be produced by cutting off strips from this. It furnishes a few useful objects, however, the simplest being the cubical box, from which chairs, stools, tables, and many other useful objects might be obtained. It also necessitates more difficult folding, and illustrates other numerical ideas.

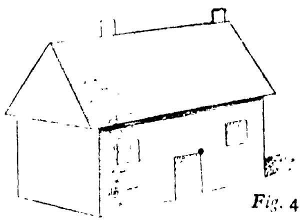


Fig. 4

More Complex Models.—The children should gradually be encouraged to make more complex models, using the above and other forms. For instance, the house shown in Fig. 4 will certainly please them more than the one already made.

The improved cottage is made from two of the sixteen square forms. The lower part is an oblong box, as described above. For the roof refer to Fig. 1. Cut away squares A, D, M, P. Cut lines dividing squares E and I; H and L. Place E on I. Bisect square thus formed by folding lower point upward inside to top. Turn strips BC and NO under, slightly overlapping. The half of square I is pasted inside these and half of E underneath. The other end of roof (a triangular prism) is formed in the same way.

The children may be led to improve on the cart they have previously devised by arranging for wheels which will turn, and shafts which are not likely to come off.

A castle (Figs. 5 and 6) which may be needed to illustrate many a story may provide work for three children. The castle is made from three oblong boxes fastened together. These may be any size, as required. The plan given was worked up from a sheet of foolscap (8 in. × 13 in.). About 1 in. is folded down first from the length to form flaps. Then the length is divided into four

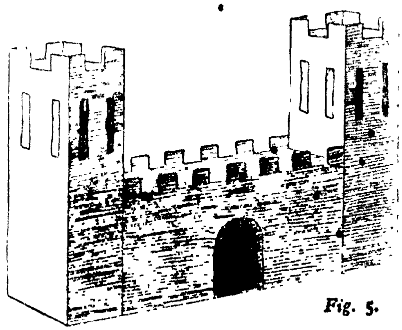
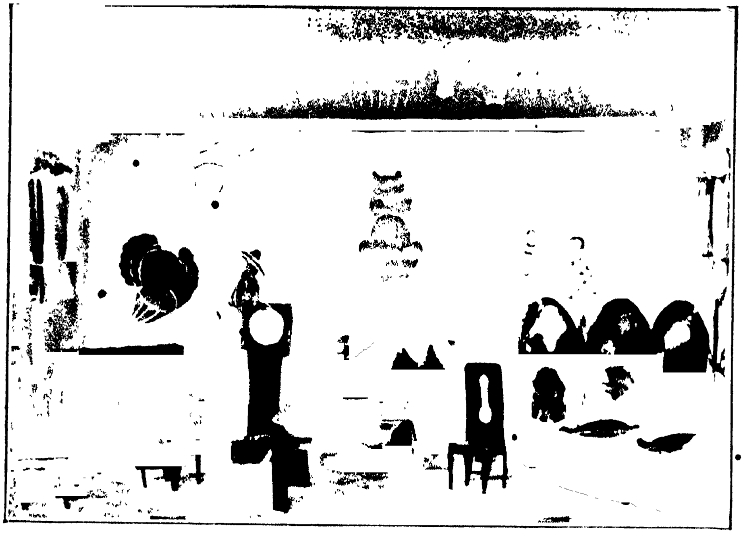
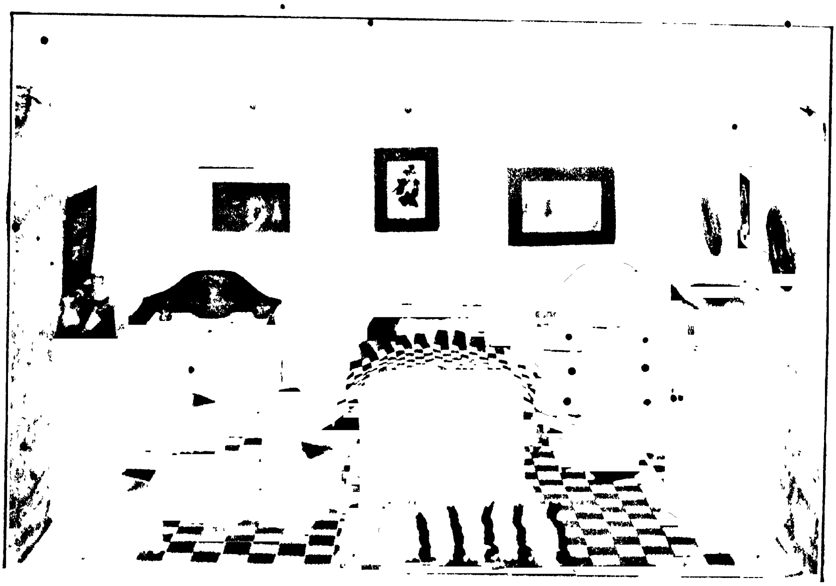


Fig. 5.



FURNITURE FOR DOLLS' SITTING ROOM MADE BY SEVEN-YEAR-OLD CHILDREN



FURNITURE FOR DOLLS' BEDROOM, MADE BY SEVEN-YEAR-OLD CHILDREN

S II

GROUP WORK ILLUSTRATION FOR "HIAWATHA."

TOYS, GIFTS, AND DECORATIONS FOR CHRISTMAS MADE BY CHILDREN AGED SIX TO SEVEN YEARS.

and the box is made up by pasting flap over the opposite edge. Battlements, doorway, and windows should be done in free-cutting according to taste of the children. For the middle portion battlements must be *added.*

The following are suggestions for a few toys which all children like making, and which may be included in the work at appropriate times.

The Windmill can be made by little children (see Fig. 7) as follows: Fold and cut square of paper as shown. (Dotted lines represent folds, thick lines signify cuts.) Fold over to centre (without creasing) points marked ×. Pin through to the top of a thin stick, loosely, so that paper will revolve when blown, or when the child runs with it.

A Kite can be made by older infants. Directions need not be given for this; the boys will know how to proceed.

A Parachute which furnishes much entertainment for a time is made from a square of tissue paper. The four corners are tied up each with a separate string. The four strings are joined, about 6 in. below and attached to a stone or other weight.

The Cracker (see Figs. 10 and 11) is a toy which children often make for themselves. They derive much amusement from making the two loose wings meet with a sharp "crack!" by sliding the thumb and forefinger sharply upwards from the bottom. To make crackers, fold and cut a square of paper as in Fig. 10. Next fold both edges to middle. Hold paper so that cut is on the left, and turn the loose wings outwards making sharp fold at bottom of slit (Fig. 11). When the bottom is held in left hand, the thumb and finger of right hand slide quickly upwards, making the two wings meet with a sharp "crack."

At Christmas-time attractive objects may be made for the Christmas-tree or for decoration, *e.g. a "bon-bon" box* (Figs. 8 and 9). To make bon-bon box: Fold and cut a square of paper as in Fig. 9. No pasting is required. Make up by turning back the "ears" of portions marked A, putting through the slit in opposite portions marked B, then flattening out again. Decorate with drawing, or cut-out paper of another colour.

Very pretty *lanterns* may be made from the diagram given (Figs. 12 and 13), if the paper is first coloured by wetting

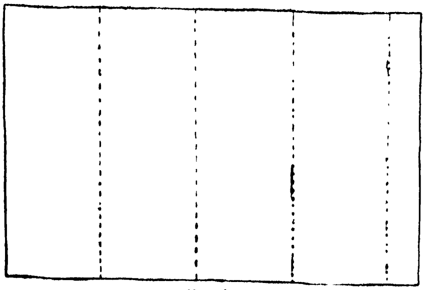


Fig 6

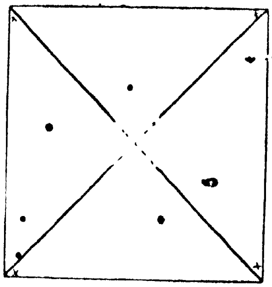


Fig 7.

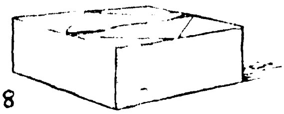


Fig 8

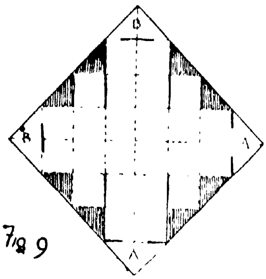


Fig 9

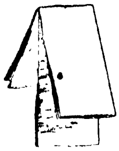


Fig 11.

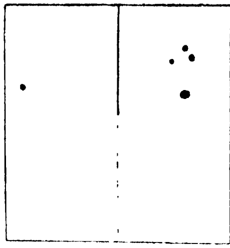


Fig 10.

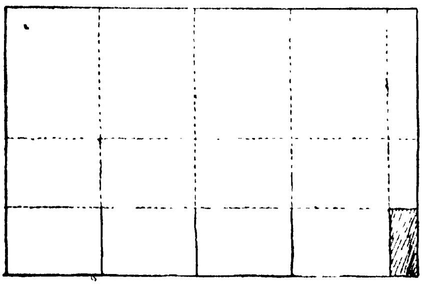


Fig 12

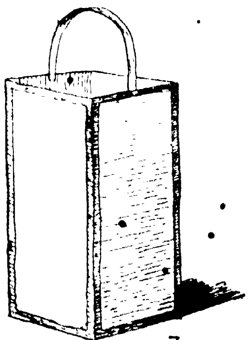


Fig 13.

it all over, then running in primary colours and allowing them to blend; or wall-papers may be used. An oblong piece of paper, size as required, is folded and cut as in Fig. 12. For this plan foolscap size was used. About 1 in. was first folded down from length to form flap. Then the length was divided into four. One quarter was also taken breadthways to form base, for which the four lower portions in Fig. 12 were pasted under each other. After shaded portion was cut away the flap was pasted over opposite edge.

Christmas crackers can be made from oblong pieces of brightly coloured paper fringed at two ends, and rolled up and tied 2 in. from each end, after cut-out figures, mottoes, or little plasticine toys have been enclosed.

The work here suggested will find, with the necessary additions of free work and group work, and encouraging gradual improvement in the work, scope for children of infant school age, or for Standard I., where this class is in the upper school. Towards the end of this year the ruler may be introduced.

The Introduction to the Use of Plans.—The word "plans" sounds perhaps more advanced than is actually meant. The children can, however, be prepared for using plans afterwards by continually making drawings on the blackboard showing the flat paper in various stages. This should be done from the beginning. The children may first make a "picture" of their square of paper, then draw it as it looks when folded, and again when it has been opened out (using dotted lines for creases). After cuts have been made, the part cut away may be removed from drawing and cuts indicated by coloured lines. As a variation they may be requested at certain stages in the lesson to "make their papers look like teacher's drawing."

Again, in the type of lesson where teacher and class investigate a finished model to discover the method of working, they may together build up on the blackboard a representation of the flat paper indicating folds and cuts. Very occasionally the children may be allowed to make a model working entirely from teacher's drawings of the various steps. This involves thought, and the children will take much pleasure in applying their ability to read the drawings. At a later stage, after the children have

made original models, they may be asked to make similar drawings showing the various steps. This kind of work will give children practical acquaintance with the meaning and use of diagrams and pave the way for making working drawings and plans of solid models at a later stage.

Materials.—The materials used should be as "homely" and inexpensive as possible. The teacher should be resourceful in making the most of any scraps she has at hand. If only special materials are used, such as are supplied by "educational" firms, the child forms the idea that these are necessary for the work and therefore does not attempt to amuse himself with similar occupations at home; and, moreover, the opportunity for training in economy and resourcefulness is lost.

For paper, old writing and drawing papers can well be used up for free work. Newspapers and parcel wrappings can also be utilised, while wall-papers make an excellent material. Most homes can supply the remains of rolls of wall-paper left over from the visit of the paperhangers, who will also usually give or sell for a few coppers, to a teacher, their last year's pattern books, which are most useful. Since the use of old writing and drawing papers is likely to produce a tendency to untidy or careless work, "special" pieces of paper should sometimes be used, such as wall-paper, proper modelling paper, or tinted drawing paper, and this should be an incentive to careful, neat, and clean work.

For fixing, ordinary pins may be used for temporary work. For more permanent work small paper fasteners or adhesive must be used. Where it can be used up quickly home-made flour and water paste is the simplest thing. Failing this "Gloy" is clean and serviceable, as is also "Higgin's Vegetable Glue," and the latter has the additional merit of never fading the papers. Infants should be supplied with a small saucer between two, and a brush each. A "dip" of the big paste-brush on to each saucer should supply both the children with enough paste for a lesson, and without waste. Teachers are advised not to use the papers which can be bought ready gummed on one side for modelling, There is no saving in apparatus—the children still needing saucers of water and brushes; moreover, the models "cockle" up when

dry, and the children miss some good training which the neat use of adhesive must supply.

Scissors for infants should be blunt-pointed. Each child should be supplied with a large envelope in which to keep useful scraps of paper, unfinished models, scissors, pencil, etc. The making of these envelopes would form a good exercise for the older children.

Teachers and Books.—Teachers should rely on no book for their models or courses of work. Having grasped the underlying principles, and made a few typical models, they should be able to invent and plan for themselves. Suggestions may, of course, be obtained from books, but a teacher who relies exclusively on other people's plans and schemes can never expect to train children to be inventive, original, and self-reliant.

BOOKS FOR REFERENCE

M. Swannell *Paper Modelling* (Philip) E. L. Robinson: *Paper Modelling for Little Children* (Sisson & Parker). Henrietta Brown-Smith (Editor): *Education by Life* (Philip) John Dewey *The School and the Child* (Blackie). Annie B. Wood *Paper Modelling for the Little Ones* (Charles & Dible).

XXXIII. THE DEVELOPMENT OF BRUSHWORK

By EBENEZER COOKE

Teacher of Drawing in the King Alfred School; Instructor of Teachers' Classes; Writer of the Article on "The A.B.C. of Drawing" in the Board of Education's Special Reports; Author of the Board of Education's "Alternative Syllabus for Drawing"; Student under Ruskin, and for twenty-six years Teacher of one of his Classes.

Brushwork as Expression.—Brushwork is part of an attempt to follow the development of drawing in the child, and to exercise the elements necessary to educate the child through expression. That the elements of expression in drawing are formed by the child itself has received independent support recently both in Germany and Italy. The first practical paper at the International Congress on Drawing, Dresden, 1912, by Herr R. Burckner, was to show that "the child finds the forms of its ornamental art in the natural movements of its hand" (and arm). Professor Elsener said later, "We all believe it here." More recent independent and unconscious support is given by Dr. Montessori, whose experiments (like Mr. Liberty Tadd's drawing in America), have their source in Seguin's treatment of the mentally deficient. Seguin found that hand movements developed mental power. Dr. Montessori's success in teaching young children to read and write so early is due to the fact that knowledge of the forms of letters is acquired through manual movement, muscular sense, and touch.

Firm Point or Brush?—As so much is due to movement and muscular sense, what material or means are best to use, and what exercises can be suggested?

The firm point would seem best, for it appeals to the tactile as well as to the muscular sense, and it is the most natural and the easiest. The brush must be a later product than a finger or a stick. The Greeks and Japanese use the brush easily, and their work is supreme. The Greeks decorate their vases that

are made by rapid movement of non-resisting material and delicate control of the hand with the brush in the same way. Until our methods were modified somewhat recently by child study we required laborious effort, finger work, and accurate imitation—which intensifies grip and pressure of hand and fingers—the reverse of Greek methods. Authority saw no advantage in non-resisting materials, and the suggestion that scribble and its movement were of use was *literally laughed to scorn. Pencil*, chalk, and charcoal afford some support, the brush does not; but the natural lines of the child's scribble, although made with a firm point, are made rapidly without pressure, just as brush lines are made. The hand flies over the surface without rest or haste, as easily and quickly as a swift flies through the air, with but little support, and less resistance. At first the form is determined by arm structure and movement. The child really begins with movement and muscular sense, and from these rather than from sight or touch knowledge is gained.

The Brush.—Brush, water, and colour are all new. Some experience may be gained with a firm point, but the flexible brush and its rapid movement require appropriate exercise. The brush itself should be well made. Raphael himself could not work well with a bad brush. Children should be treated fairly; they should be given adequate tools. The sables of the Alma School did much towards establishing brushwork and colour. The best materials are not always to be had. The Craft School pioneer work was done with inexpensive brushes. The two lower patterns in Plate facing p. 92, Vol. I, illustrate their work, and Plate facing p. 107, Vol. I, also. But they might have been done with sables. The brush cannot transcend itself. The blobs at top of Plate p. 106, Vol. I, are all that an old brush whose point has been worked off can do; those at the lowest corner (28) are from a brush with a point. Perfect execution, as well as perfect conditions, is rare. Greek work, a good standard, is very human and very far from mathematical accuracy.

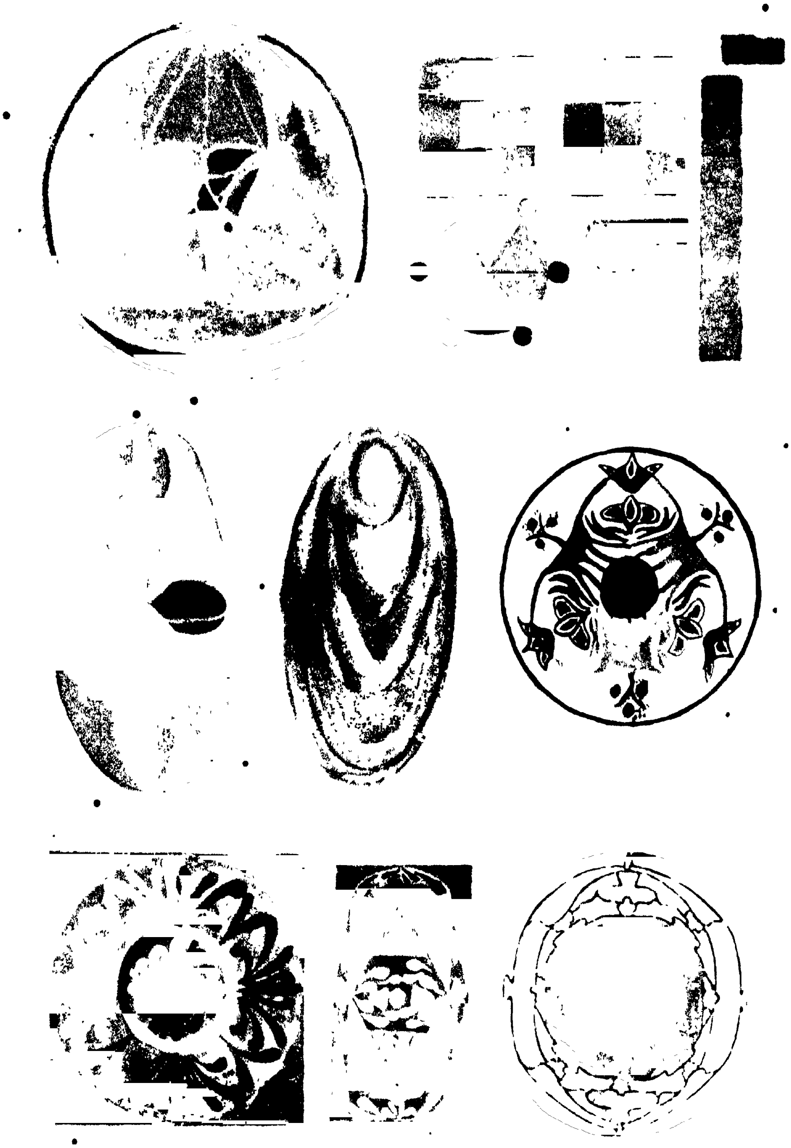
Brush Elements. *The Blob.*—The ovate shape of the brush agrees with the child's first expression of form; and as that form is easiest to make, from the way in which the arm is constructed, so the easiest form for the brush to paint is its

own portrait, for it is the result of its own shape and structure. If the brush, filled with colour, and held equally between thumb and two forefingers, is pressed down sideways on the paper, point first, and taken up again without shifting or blurr, its own ovate shape is impressed (see Plate p. 106 (22, 27), Vol. I). This blob more than anything else caused the brush to be put into the child's hand, and opened the school to colour. Every child can make something presentable with it, and chaotic mess is ousted by order, shape, and rhythm. The child begins with a germ form of drawing in which there is both pattern and picture; and this blob can be used for both. It can be easily modified to express living forms, or it can be put together in rhythmic order for simple patterns.

The exercise of making patterns should be encouraged while the child has still its early initiative and invention; and design should begin with its own simple doings. The cry that design is impossible will be lost in invention. Unfortunately design was not, and is not yet, understood. It is the mental basis of brushwork, as it is of drawing and of all art. No sentence can be uttered, no drawing done, and no work of the hand made, until it is constructed in the mind, and means then adapted to express it. In the first form of drawing, which is self-expression, the means of expression must be adapted to the mental image before it can be sent to the hand and executed. At first all means may be incomplete, but the working out by the hand helps to complete and will develop the power of mental construction.

The blob can be used by a child to invent in play; but to substitute imitation, or the invention of others for the child's own inventions, is to take the essential educational element out of the exercise. This was done by many to such an extent that the blob was abused—its real value was not seen. Imitation is valuable if it is subordinate to invention, and is succeeded by it. Brushwork has suffered sadly, because its inventive element has been ignored and imitation put in its place.

The Stroke.—If the brush is held as before, and is moved along horizontally—graduating the pressure—and then gradually taking it up, the blob is extended into an ovate "stroke." This stroke is made most easily at first, vertically. Place the point



COLOUR AND TONE.

on the paper and move it along, increasing the pressure until the full width of the brush is in use, and then gradually take it up (Plate p. 106 (28), Vol. I). The greatest width may be at the beginning, middle, or end of the line, which may be straight, curved, compound, or complex (Plate p. 100, Vol. I, lower figures). This "stroke" is essentially a line, made with the brush and graduated pressure; and it connects line and mass. As the child thinks in line, and the mental effect of this is linear, it is best to consider the stroke a line. Design thus becomes easier.

The brush at first is placed horizontally for the blob, but the stroke passes through all angles and ends vertically. By using the point only, and equal pressure, a fine line is made (28). Other parts of the brush, up to its own breadth, make thicker lines, if the pressure is equally maintained. Held upright the point makes a small solid circle, like the section of the brush (27).

Flat Tint.—If a brush is given to a child of three or four, it scribbles as with a firm point, but the lines are irregular in thickness as well as in form, and they pass into surfaces of colour, also irregular in form and uneven in tint. To make an even tint of flat colour, the nature of water, especially its power to run down, must be considered. Into one teaspoonful of clean water mix Prussian blue, not too dark at first. Draw a square of three or four inches, or use the open spaces in free-arm exercises. Fix the paper to a board and raise the upper end, so that the water may flow down. Fill the brush with water-colour and draw it along the upper line of the square and inside it. The colour will run down to its lower edge (Plate V, 1, 2, 3).

With the brush that has still some colour in it lead the pond at the lower edge, about half an inch down, regularly, all along. Keep the pond at the edge well supplied with colour ready to run down, but waiting to be led. When the lower line of the square is reached, empty the brush on sponge, blotting paper, rag, or side of palette. Now the empty brush will take up the surplus colour. To empty the brush do not dip it in water. The water must be taken out of it as well as the colour.

In laying the tint the point must be used to complete the form at the sides of the square. The edges need not be ragged. Also the tint often dries unevenly, and when dry it is lighter. The

tendency to retouch the lighter part is strong in children. Wait till all is dry; to retouch will probably spoil all. Beginners should never touch colour while it is wet. When this lesson is thoroughly learned, another, perhaps the reverse, may be given (Plate X, 2). Any needless disorder and bad habits acquired now are often troubles for life.

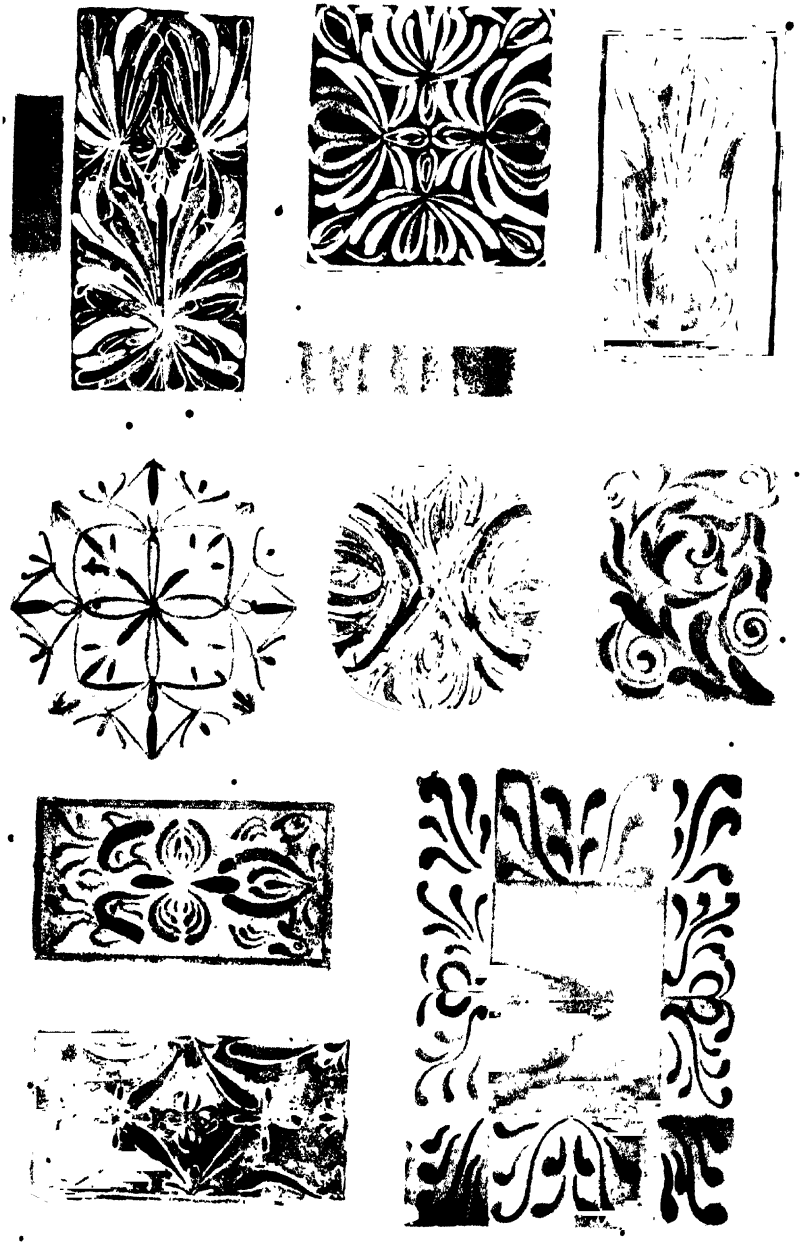
Gradation (Plate VI, 4, 6, and 9).—Children of eight or ten are quite satisfied with flat colour. Gradation is required soon. When its need is perceived by the pupil, a rough way of obtaining it is to begin in the same way as the flat tint, but, after the first or second band of colour is made, touch the very tip of the brush in clean water and lead the colour down, half or quarter of an inch at a time, and repeat the process. The water in the brush will reduce the colour of the tint a little each time, and gradually lighten it. If the space to be graduated is short, take up some of the colour with the brush. There are more excellent ways, but this is simple and practical and may be used easily. (See Ruskin's *Elements of Drawing*, p. 37, § 33.)

These elements require practice to enable the child to make them definitely and readily, but they should not all be practised much by themselves before using them for design or invention. Special elements given for design can be practised at the beginning of the lesson.

Colour.—Colour is soon added to the primary means of expression, line and form; but though a step nearer realism, it is, like form and concept, limited as a means by the child's knowledge and nature. Colour, like form, is not represented as it is seen, but as it is known. A red rose is of the same red all over. A seen rose has shadows, transmitted and reflected light and colour. An artist sees the rose as it is, and he needs the whole spectrum to paint it. The child's red is an abstract generalisation, apparently akin to others. This fact affects our conception of its early form. Abstraction and generalisation take place as early as the fourth year, so that form, although determined by hand and arm structure and movement, may also be affected by knowledge gained through the muscular sense.

Ruskin gave the first exercises for colour study. He saw

PLATE XI



COLOUR GRADATION AND HARMONY

that there were no lines in Nature, and also that colour is not separated from light and shade. He suggested elementary exercises for both. For shadows—squares in which lines were worked together into an even or graduated tint—in 1865 one of his classes gave one term to this exercise (called by Dr. Montessori "design"). For knowledge of colour, strips or bands of colour were crossed by other colours systematically (*Elements of Drawing*, p. 205, § 163)—see Plate V, 1, 2, 3, Plate X, 1. In *The Laws of Fesole* a circular spectrum of pure colour is given in circles. His followers have modified, used, and extended both exercises (Plate VI, 1, 2).

So much may be done with colour that only a few hints can be given here. A design with one colour, and one or two brush elements will fix in the mind the colour as it is in the box. Prussian blue may be followed by crimson lake, and then the two together (Plate VI, 2; Plate facing p. 92 (3), Vol. I). Gamboge by itself, with blue, with red, and then all three. These may be followed by French blue, vermilion, and yellow ochre; or blue and crimson lake may be mixed and the three used (figure 3, p. 92). French blue and gamboge, and the two colours mixed, are used in figure 1, p. 92, Vol. I. No system need be strictly followed, but there should be some scheme underlying all teaching. The children should also have freedom to use their own colours. The middle pattern in Plate, figure 2, p. 92, may illustrate one kind of freedom. The teacher selects one colour and the children the other.

In the earliest drawings pattern and drawing are united (see figures 4 and 5, Vol. I, p. 92), and the three primary colours—red, yellow, blue—are all used on a warm toned paper. The blue, green, and red are the child's own selection; and so are the colours of the Craft School patterns below (figures 6 and 7).

Later, more detailed sequences, such as yellow, yellow orange, orange, orange red, and red. Contrasting and complementary colours will arise from colour study, or from Ruskin's circular spectrum. Red, yellow, blue, crossed by themselves, in free-hand drawing spaces or in strips, will produce orange, green, and purple; and these again self crossed will result in greys and browns (see Plate V, 1, 2, 3). This will provide enough exercise for a term, or even for a year. The greys and browns may first

be laid on and the colours composing them used as patterns. The two lower figures on Plate facing p. 100, Vol. I, illustrate another sequence of orange, green, and purple. There are free-arm ellipses, hardly seen in the drawing, indicating the limits of colours; outside is orange, then orange and green, green, green and purple, and purple in the centre. Note also that the brush strokes are more compound.

For systematic suggestions the teacher should avail himself, as far as possible, of what is done in class. Knowledge of colours in the box and their combinations, something of colour harmony, and design, may be included in brushwork (Plate V, 5). The blobs being of the same size may be used for measurement.

Organic Form.—The most beautiful forms and lines, those most natural to children, and the easiest to make and the forms they like best to draw, are forms characteristic of living things: the oval and its elements. These lines are capable of almost infinite variation and combination. They are not used as elements, nor are recognised as such, and are therefore most useful; for some maintain that a child cannot invent of itself, but is always imitating something he has seen: that invention is only imitation. These forms are common in early Greek art. The brush, both in its passive impression of itself and its active expression, is ovate. The outline of the brush stroke is composed of two similar, symmetrical, elementary, organic lines, and the child's first lines in its scribble are also referable to organic general forms; of this something has already been said (see Vol. I, p. 99).

Brushwork Design.—An essential element in drawing as expression is design; and of brushwork too, for it is a part of an attempt to exercise the elements of drawing as expression. It is a part that partakes of every other part. With adaptation of means to mental content drawing begins; with adaptation of means to mental activity design begins, and is easier than drawing. The nature and elements of drawing were entirely obscured when brushwork began. Even Ruskin said, as late as 1877, "Design can be taught only by Heaven." But Heaven gives the power of design to all, and brushwork, insisting on design, began and made its first success at the Ruskin Drawing Class, College for Men and Women, in 1873; though the means at first were not pure

brush elements, but these united to natural forms. All drawing was and is called design, but the reason for so naming it is lost. The study and exercise of its means, apart from expression, have given it an entirely different meaning, and have put imitation in the place of design.

Degenerated Design.—Design with elementary lines was evidently Froebel's intention in Kindergarten drawing; but, his reconciliation of opposites not being understood, his drawing degenerated into imitation. Practical work in the Kindergarten about 1879 suggested brushwork on his chequers. The first works on brushwork were published surreptitiously from this Kindergarten; and the authors, not understanding its principles, reduced it to their own conceptions, and instead of making invention primary and essential, ignored it, and put in its place the accurate imitation of given copies, with the help of showing and telling by the teacher.

What had happened to Froebel happened also to his followers. This fundamental error spread with brushwork, and its chief educational value was eliminated. Brushwork without design and invention is not brushwork at all. Organic form and free-arm exercises are also characteristics, but invention is essential. Imitation is often most valuable, for general forms, elementary lines, hand exercises, and other important matters may be helped by it; its place is to serve, not to rule or reign.

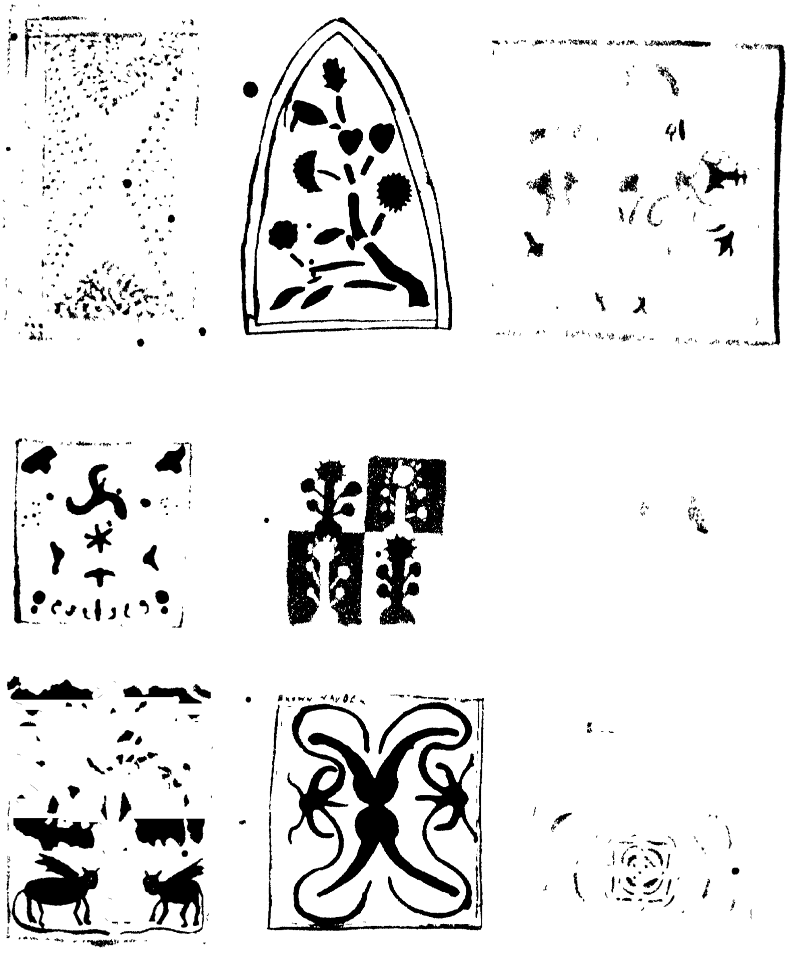
All Expression comes out of Man.—Line and form, the means of expression in drawing, adaptation of means to mental content, design, or mental construction, preceding handwork and execution—in fact, all the essentials of the first form of drawing and of its highest efforts—originate or germinate in the child, and expression is completed by its own activity. Man is so made that he must express and communicate himself; and as all men form knowledge, so all invent the means and adapt them to expression. All comes out of man. Expression appeals to the creative source of all, and draws out or develops these essentials, and so educates man.

The Means of Expression and Imitation.—Speech, one of the means of expression formed by man, is learned by imitation, with but little help, and no systematic teaching. But its mean-

ing cannot be learned so. Knowledge, like the self, develops organically, but the artificial means are taught by imitation. Apparently the more complex the art, the more artificial and imitational its teaching. Reading, a union of the two means of expression, speech and drawing, deals only with the material means; it is not a means of self-expression, and imitation enters largely into its teaching. Elementary drawing and arithmetic were taught, and may still be taught, in the same way the mental factors being ignored. Hand and eye work and imitational methods do not recognise them (design or expression) as essential. Children are taught to read without understanding what they read, and to draw without recognising the mental factors. If education is the "harmonious development of the child's powers," then separation of means and mental content can hardly be education.

Imitation and its Place.—The means of expression are taught by imitation. In drawing, straight line, arc, and geometric forms—the supposed generalisations and elements of form—have been given for ages. As we know now that form is learned, at first, at least, by manual movement and muscular sense, more than by sight, the general organic forms and elements may be given for imitation for the purpose of forming knowledge through movement. (See Plate p. 106, Vol. I.) But to exercise the means only without the mental activities is not drawing, nor education. Invention and design should enter into every elementary lesson. If we imitate the means, the principle of discovery is not abandoned. A boy discovered or rediscovered the blob and at once adapted it to form a running rat by adding ears, legs, and tail. So delighted was he with his discovery that he repeated it through his drawing and over the margin. Imitation of form by free-arm movement leads to knowledge of the means of expression through muscular sense, as well as by sight; but the means alone are not self-expression. Mental content must be added, and it is to this that the term discovery applies. The child discovers and invents so much instinctively that we may rightly expect much from him if we appeal to the wonderful possibilities within him. The more he gives the more he gets.

Design.—"Design is possible only to Heaven." No; it is



DRY WORK AND BLOTS

implied in all we do and say, in all art, and all expression. To make it explicit, to make the inner outer, should not be impossible. The chief cause of difficulty is our incomplete conceptions of drawing, teaching, and education. In drawing all comes out of the child—so observation of the development of drawing teaches—means of expression, adaptation, design, correlation of mind and body, control of hand. The child forms the means, and adapts material and means to mental content. In other words, he puts ideas into words or forms. This the central creative process in expression. It takes place within the child, and by its own activity. Design and mental construction follow the correlation of hand and mind, and the power to convey to the hand and control it in its execution. All is germinated and developed in the child. But our hand and eye work and imitational teaching ignores all this; and some think it possible to put design into the child or student by imitation and cribs. Such teaching must be turned quite round. Something of the inner mental operations must be known, and of the power of design which Heaven gives to all.

The Beginnings of Design.—To exercise invention the simplest means and materials may be used. Play, not mentally beyond noughts and crosses, will develop power. To put intentionally two lines or brush elements together and to repeat them in order will make a border, or diaper pattern. Others will soon come. This little way leads to the high road, and to higher regions. The refusal to begin with what can be done because it is childlike, arrests development. To adapt Bacon, "The kingdom of art is like the kingdom of heaven in this: only by becoming a little child can we enter it." Head and hand interact especially at first. The whole pattern is not at first, nor always, clearly and completely conceived before beginning to draw. Do what is possible, even if this is incomplete, and the next step will be clearer and better. Hand and head work together and help each other and develop together. Thought and act should be the child's own, and it will be power to itself. Illustrations may help.

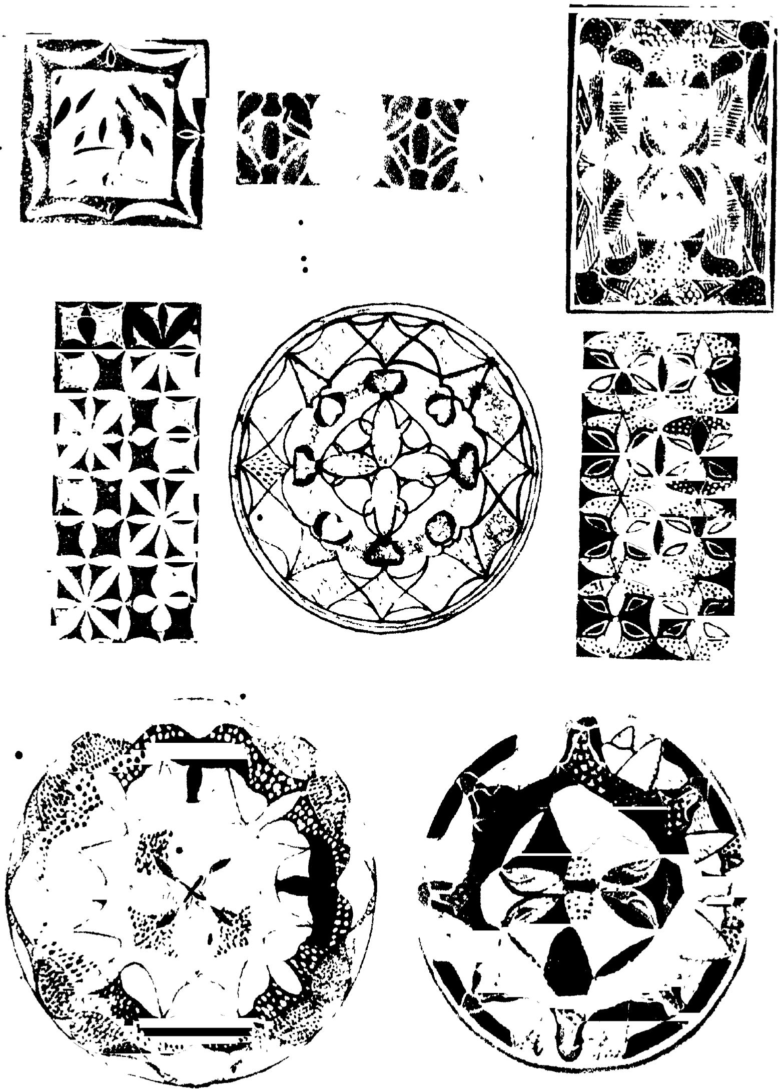
Imitation becomes Expression.—Imitation at first becomes expression. Children in a Kindergarten were given for imitation simple animals, birds, and other living things made before

them with brush elements. At three and a half years only irregular scribble, passing into formless masses of colour, was made. At four years there was separate mass only. At four and a half years more definite form appeared—legs and head, and a big face that was not given. One child made definite forms, but some sitting, others with legs upwards. At five years the forms were still vague and irregular, but interspersed with scribbles, like early Greek drawings—pattern and picture in one. This was not given. In others of the same age the form gets cleared, but butterflies and birds and figures not given occur in four cases at five and a half years. Birds swimming and lines for water complete their doings, but these were not given. Children cannot imitate the forms given; they are stimulated by the teacher's work, but express themselves.

Early Brushwork.—The eldest of three children, a girl of nine, took the lead and played with her brothers at drawing. Each brought five or six large sheets of paper full every week, and after a short holiday there were fifty or sixty sheets. Pattern and picture are united (see Plate p. 92, Vol. I (4, 5)). Borders and the blue flower of three blobs may have been suggested by lessons, but all else is their own. In the borders the unit is repeated without accurate measurement. The colour also is their own.

Chequers given.—Pestalozzi and Froebel gave chequers as a basis for inventional drawing. These educators were the first moderns to recognise design as an essential element in drawing. Brushwork began in the Kindergarten about 1880, and it followed and developed the method of its founders. These chequers suggest places, sizes, and direction for brush elements, and help invention, order, symmetry, and contrast; but the chequers should not be less than one inch square or wide. Oblongs are better, and children should make their own chequers. With chequers, borders and simple patterns are easy, and a very great variety may be found.

Basis made.—Plate p. 92, Vol. I (2), was based on chequers or measured spaces and arrangements of straight lines made by children. To rule lines and to make geometric and other straight-lined forms was, at the time (1896), part of the drawing required.



COLOUR: GENERAL EFFECT

This work was used as a basis for brushwork. It provided variety, and exercised invention with straight lines. It was made by the children, and was of an appropriate size. This basis gives precision to their brushwork.

No Chequers.—In Plate p. 92, Vol. I, the two lower patterns reverse the above. There are no lines, no measured spaces in these patterns, but of course they are generally used. In Plate p. 107, Vol. I, there were obviously underlying freehand forms. Both the child's method and the man's are used, and probably both are right.

Free-arm Basis. —In Plate p. 92, Vol. I (1–3), is another method, based on free-arm drawing. Arm movement is most essential, and there is never enough of it. The free-arm drawing is at first imitational. It is used to exercise form, measurement, direction, handling, and design. A drawing is made on the blackboard, the class follows with charcoal and copies it, and sometimes helps or suggests. The charcoal is dusted off, the brush is filled with colour, and the lines are run over with a free-arm movement just as with the charcoal, except that the brush should be held upright and the chalk not. This is excellent practice. At first the brush may run over the lines several times, until brush, hand, and movement work happily and accurately together. The aim should be to make the brush lines at once, and this can also be done; further practice must be modified to suit the requirements of each class. Free-arm exercise by itself (Plate p. 106, Vol. I) has already been mentioned. It may remain an exercise of line with firm point. Brush lines may follow and tints for colour study fill the spaces, or finally brushwork may be done. Advanced students may not be able to give more than one term each year, and they may be able in this term to get through all these exercises. Younger children, who do not work so quickly, may proceed more slowly.

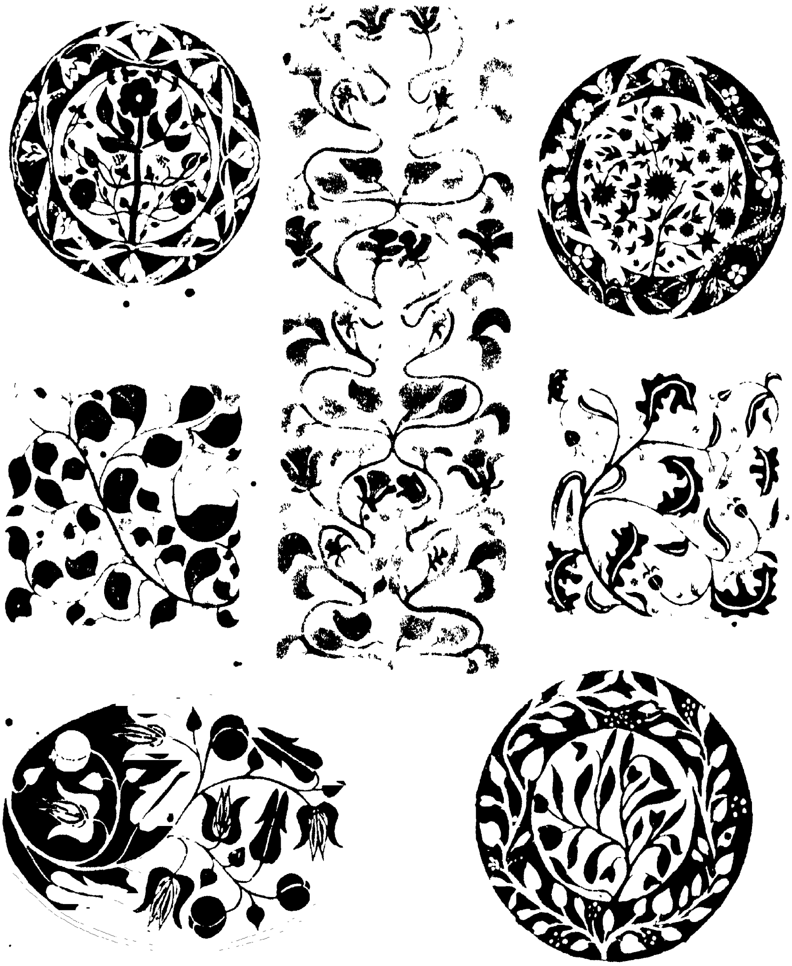
Class Work to be Interacting.—Once, when systematically developing organic forms found in the scribble, the ellipse (Plate p. 92, Vol. I (3)) became the subject of a lesson. Its quadrants were discovered and emphasised by the four straight lines, and an inner parallel series, with a circle in the centre, was reserved. After free-arm exercise the class was given two colours blue

and crimson lake, and their mixture, violet; and two strokes, straight, and the newly discovered quadrant of ellipse; to fill the spaces as they wished. The four quadrants were put together in the centre to form a bird and its perch by the teacher, to show their elementary value. A more beautiful design, made with the same elements, was brought the following week and shown to the children.

Suggestions from the Class to be used.—The free-arm scribble form (p. 104, Vol. I (7) had been used for a lesson, and during the week each child in the class made a new design from it without help. One boy made the two ovates much broader, put four smaller ovates inside them, and filled the spaces or bands between with smaller pattern, made with the same elements. This suggestion was adopted as the basis for the next lesson. One half was changed from ovate to oval, and the suggested method of filling it was adopted. A double curve was allowed for brushwork, and for colour, blue and yellow and their colours were mixed. The original is, of course, better colour.

Home Work to be a connected Course.—The Plates Brushwork Design, pp. 98 and 100, Vol. I (KK. entirely alone), free-arm and brushwork, may illustrate a term's work. Figs. 1 and 2, p. 98. The initial scribble is evident; 3. Ellipse; 4. Circle divided into six parts and simple strokes used (free-arm pattern is used and may be detected underlying this and others following); 5. Divided in 5 angles, 72°, compound strokes. 6. A "growing" pattern same basis. Plate p. 100, fig. 1. "Growing" pattern. 5 and 6. Colour green, orange outside, then orange and green, green, green and purple. These are more advanced. We should make sure the beginnings are right, and the work will develop of itself.

Play.—What was said about design with free-arm drawing, p. 106, Vol. I, applies equally to brushwork. Children can make chequers (Plate p. 104, figs. 10, 11, 12, 13) and play with brush strokes, together or alone, for strokes are only lines brush made, and are better than simple lines. Combinations of their own inventions, as Plate p. 106, fig. 22, Vol. I, can be repeated for borders, as in the next figure (23). This pattern is based on sixteen square chequers. Blobs, strokes—straight and curved—and fine



GROWING PATTERNS: COUNTERCHANGE EFFECTS

lines and dots, are all used. If something of this kind is done with the class, and they know that afterwards they will have to make another pattern with the same materials, variations will suggest themselves as it proceeds. They may be heard saying, "I know what I'll do." This kind of pattern with brush and form elements we call "abstract," or elementary.

"Growing" Patterns.—The next pattern (24) suggests a plant, and we call it a "growing" pattern. The brush strokes made at once are foliaceous. If the chequer lines had been left they might have shown how the distribution of elements fills the space. There is also an indication of two tints, light and dark, which is a useful arrangement. The other abstract patterns are more complex. Number 26 is based on oblong chequers and fusiform strokes; 27 on squares, with ovate strokes. Animals and plants are suggested easily by brush elements; even children can find many more, and they easily add the appendages.

In a school in the East End (London), where growing things are scarce, the children produce abundance of simple, archaic, and beautiful "growing" patterns—pure inventions, like nothing alive though reminiscent of Primitive Art (see Plate IX, 6). Their patterns they take beyond brushwork into wood, clay, iron, copper, and other materials, carrying the characteristic forms with them. This tends to give their work a style of its own. One use of brushwork, by itself, is to exercise and develop the ability to design. For this it is specially valuable. An exercise with brush direct, without charcoal or any preliminaries, is seen in Plate IX, 2.

Invent New Exercises.—An entire course of brushwork need not be given, for every one can make a series of exercises to suit the needs of each class. For more than thirty years several courses have been given each year to several classes, but except the first obvious patterns from scribble none are repeated. Every year and every class has its peculiarities and its own patterns, while they include all general forms, colour, and elements. We try to make patterns suited to the needs of each class. Children often help and suggest. Teaching is not educative unless class and teacher sympathise and interact. If the child's powers have been exercised, they will be developed, and he will go on by himself, and his work will become more complex. He does more

wonderful things himself by following the instincts of his nature. He forms knowledge, means of expression, adapts material means to mental content, designs what he desires to express, and controls its expression. To continue this self-activity by providing exercises is apparently a small matter, but it is most important, and is in our power from the first lesson. They should go on by themselves. Many combinations are actually made by the mind that have never been made or seen before. Mind puts together its contents in its own ways, and, if we use the power it develops, we cannot put any thought or idea into material form, nor express it in any way, without first adapting the means to the mental concept. Drawing is design, and design is infinite.

One boy at a Craft School, who was delighted to discover he could invent patterns, determined to keep a record of them in a book. He did so for a time, but he found he could make so many that he could not put them all down. Some of them may be found to-day in the varied and beautiful title-pages and end-papers of the books of the *Everyman's Library*.

Elements of Drawing as Expression.—Brushwork is only a portion of an attempt to exercise the natural elements of drawing as expression, the prototype of all drawing—the child's and the greatest artist's. It is the expression of the artist's self that gives his picture value. Drawing, when acquired, may be applied in various ways. To-day, and in this country, it is applied to the imitation and accurate representation of objects. This is art applied to science, and a most valuable application it is at the proper time—its aim is to form knowledge, to eliminate self. Art requires knowledge. Science and art are complementary, but self-expression is the final process of that interaction of man and nature that develops him.

THE PLATES

[NOTE.—Owing to the sudden death of Mr. Ebenezer Cooke before he had finally arranged the illustrations for this article, his son, Mr. Gilbert C. Cooke, Principal of *The Craft School*, Stepney Green, London, has arranged the illustrations and written the following notes on them.—EDITOR.]

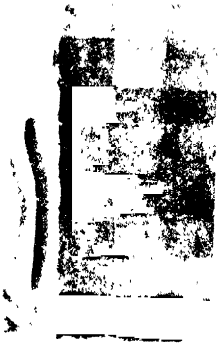


ILLUSTRATION AND REALISTIC REPRESENTATION

It will be noticed that a number of the figures shown, and the methods and processes employed, are not alluded to in the context, which deals with the beginnings—those beginnings which must be sound and sure. It was obviously not the author's intention to introduce all this matter at this time. The justification for its inclusion now is, that these specimens serve to demonstrate a few more of the directions in which Brushwork may be developed and applied, for the purposes of education, in the hands of those who accept and work upon the first fundamental principles which have been enunciated in these articles.

Plate V.—(1, 2, 3) Various exercises in producing colour mixtures.

(4) Specimen of free-arm use of brush, showing hard and soft effects produced by manipulation of wet and dry edges.

(5) Design which includes the whole gamut of colour, from primaries to seven variations of the tertiary.

(6 and 7) Designs illustrating effect produced by working with primaries over tinted grounds, with and without white.

(8) Tone pattern with hard edges and white dividing lines separating flat masses.

Plate VI.—(1) Scale of colours between yellow and blue, its application to pattern, outlined in white.

(2) Scale from red to blue and application to pattern on white ground. Ragged strokes made and introduced purposely.

(5) Application of both scales to a pattern, in which ragged outline of ground is intentional.

(3, 7, 8) Patterns with coloured outlines using primaries, secondaries, and tertiaries.

(4) Gradated effects with one colour.

(9) Gradated effects for purposes of decoration and representation.

(6) Gradated ground covered with pattern in which blended effects are produced by softening wet edges of different coloured strokes (see No. 4, Plate V).

Plate VII.—With full and dry brush. The specimens shown deal more particularly with the exploitation of the inherent properties of the medium and natural effects peculiar to these.

(1) Arrangement of blots of colour shaken or pressed out of

the brush and spread over the surface in varying degrees of density.

(4) More complex blot, or puddle, forms produced by modelling the simple form in No. 1. Variations obtained by a process of moulding or extending the edges by leading wet colour about with point of brush.

(8) Evolution of stream line, colour led out of blot.

(2) Application of lines and puddles to produce a growing pattern. Each separate part of this design is composed from one blot. Pattern in stencil form and applicable to pierced metal. Note accidental blot outside edge of pattern.

(5) Counterchange effected by working puddle outwards to form pattern and by guiding it inwards to cover ground.

(7) Suggestions of tree and animals.

(6) Continuous string line pattern produced from one wet brushful of colour and showing intentional inflection at intervals.

(9) Strip of lines, wet to dry, produced by exhausting one fully charged brushful of colour.

(10) Application of (9) to pattern making, showing evolution of brush stroke.

(3) Pattern of wet lines and puddle shapes showing evolution of brush stroke.

Plate VIII.—Tones and Textures.

(2) Contrast and counterchange of tone and line.

(1) Stroke forms in outline and mass. Introduction of half-tone as texture composed of brush-point impressions

(3) Effects of tones by variation of texture, obtained in some cases by removing patches of pigment and allowing ground colour to break through.

(4 and 6) Combination of colour masses and textures.

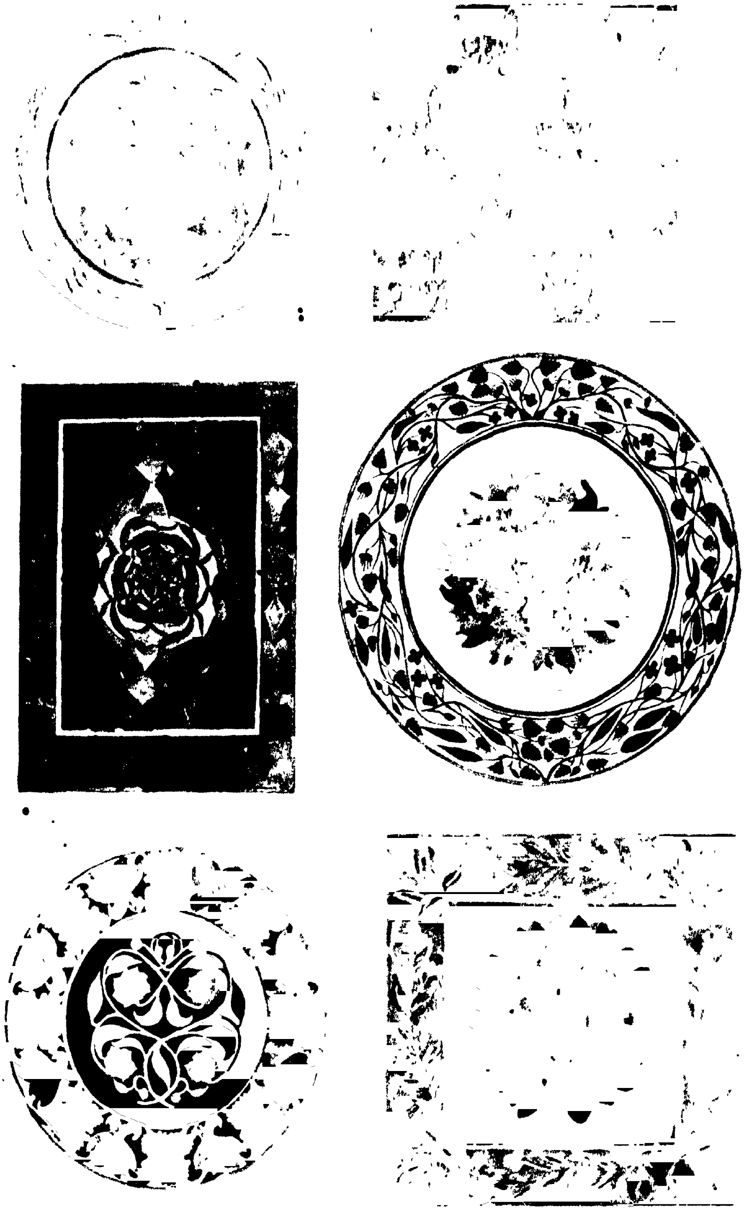
(5, 7, 8) Examples of effects produced by the breaking and intermingling of colours, consideration being given to the value of white.

Plate IX.—(1, 3, 7) Examples of counterchange arrangement of colour with two fully contrasted tones.

(4 and 5) Patterns in which the variation of tones is introduced. Note how midribs of leaves are washed out in No. 4.

(2) Repeating pattern; an example of direct and rapid work.

PLATE XI



DECORATIVE COLOUR SCHEMES

Plate X.—The application of brush and colour to purposes of realistic representation.

(1) Wet and dry brush strokes. Scale of colour produced by crossing selected palette of red, yellow, and blue.

(2) Application of (1) to produce sketch of landscape. Note steps in the process by which this is worked out which exemplify various exercises introduced in the preceding plates—viz. Gradation (Plate VI, 6, 9) sky. Hard and soft edges (Plate V, 4); furrows, middle distance, etc. Wet blending and puddling of colour (Plate VI, 6, and Plate VII, 4) uncultivated portion of field. Working with dry brush over dry washes (Plate VII, 10); copse in middle distance. Wiping out (Plate VIII, 3, and Plate IX, 4) clouds.

(3) An imaginative composition for figure subject. Little of the effect is obtained in this case by blending or running wet colours together. As a rule, one colour is worked over another after it has dried. Compare treatment with No. 2.

(4) Local study in colour in which effects of texture (Plate VIII, 6) are included.

(5 and 6) Colour studies from nature. Broad effects of light and shade and colour; application of exercise (Plate V, 4, and Plate VII, 2 and 5).

(7) More highly finished treatment.

Plate XI.—Experimental colour schemes.

(1 and 2) Counterchange effects of warm and cold colours.

(3) Patchwork pattern.

(4, 5, 6) Variations of massing proportion and arrangement of white; compare treatment of centre field patterns—note soft blended effect in Fig. 6.

Plate XII (Frontispiece).—Specimens to illustrate the height of efficiency to which mastery of medium, excellence of technique, perception of colour, and appreciation of beauty may be developed by practice and application of Brushwork. Compare the handling of each specimen.

(1) Local study from nature carried to a state of high finish.

(2 and 3) Broader and more direct treatment.

(4) The record of a passing effect of light rapidly and directly executed. Illustrating how the trained hand and perception can apply knowledge and power for purposes of expression.

XXXIV. SYSTEMATIC RECREATIVE WOODWORK

By H. Williams Smith

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and D. Poad

Teacher of Handwork; Teacher of Recreation Classes for Mrs. Humphry Ward

Children's Play is Essentially Educational.—Everybody had the privilege once to be a child, but it has been, and is given, to few to be indeed "children of a larger growth." It is these few, however, who have been, and are, the world's greatest ones. The hard saying, "Except ye become as a little child," is easier to accept and act upon than such a saying as "Except ye *remain* as a little child." The world's greatest men and women have ever kept more of the childlike about them than ordinary grown-up mortals retain; for them "the vision splendid" never does "fade into the light of common day." The greatest teachers have, of course, been distinguished by this retention of the childlike, and so from them, in descending scale, every man or woman who is more or less worthy of the honourable title of "teacher" must remain at heart a child: so only becoming serviceable in their day and generation.

The true teacher would never dream of using the word "childish" as a term of reproach, nor does he ever wish to "put away childish things." He knows that one of the most serious pieces of work in the world is a child's "play." He knows that the boy's tip-cat and stick, and the girl's battledore and shuttlecock, are evidences of greater and more essential educational processes than are ever carried out on the golf-links or in the tennis-courts. But he knows, too, how difficult it is for adults to join in the play of children without transforming their sports

and games into ghastly simulacra. The best that we adults can do is to exercise an unassertive, benevolent supervision; to be on the spot wherever and for whatsoever we are required; and to keep well out of sight and hearing when we are not wanted.

The Use of Organised Games and Constructive Play. This is not arguing against what are known as "organised games." It is as absolutely necessary to organise games for the children as it is absolutely impossible for the ordinary person to do such a thing. It is to be feared that this part of school work should often be more truly named disorganised games. It is good for the children that gifted beings of greater physical and intellectual development should teach them games; it is better still that the gifted beings, if they enjoy the games, should play with the children; but it is best of all for the gifted beings to exercise most of their energies, and to spend most of their time and money, in providing proper apparatus and suitable environments for games, and then to leave the rest to the bairns. This best of all may be extended to include a better still, and that is, that the children *make* as well as use the apparatus for games.

Children love "making" even better than play, although their play is always a "making" also, if it's only "make-believe." The boy gets rather more delight in hacking out a boat with his jack-knife than in sailing it afterwards; while the girl enjoys as much or more the making of a new "pinny" for her doll as playing with "the sweet pet." This is justification enough for such a scheme as is here laid down. To bring further arguments in proof of the desirability of including a games course in these volumes would be a waste of space which might be filled to better advantage.

The Nature and Purpose of this Course.—The compilation of this course has brought under tribute every previous publication on the subject and on cognate subjects known by the authors, and also every other available source in their own experience. There is no such thing existing as an absolutely original manual-training course of instruction. The most that is claimed for the present one is that, so far as the exigencies of the case allow, it is representative, suggestive, and graded as far as possible to admit of the proper introduction of tools, and progressive training in

technique. After all, the best thing a formal course can do is to set the children thinking on the subject. When interest is aroused, and a certain degree of dexterity is attained, it is far better for them to hunt up suitable problems for themselves—problems growing out of their individual and present needs—than for the teacher to set the problems.

Yet a child should attempt nothing without reasonable hopes of success. He must learn to handle tools and manipulate materials; he must develop a facility of "thinking in shape," as Thring of Uppingham called it. But so soon as he can run alone, he should be permitted to do so. The interest which a child must take in his work, if he is going to obtain what is educationally best out of it, is inherent in the present course; but it would be easy to kill that interest by unwise procedure on the part of the teacher. To avoid this, perfect accuracy in production must not be expected, but relative accuracy, according to the pupil's ability, should be insisted on and striven for. If the toy will work, or if the games implement can be played with, the making is justified in the using; but the better the thing is made the greater the subsequent pleasure.

So far as the authors are aware, this is the first attempt to compile a woodwork course which shall be subservient in its entirety to the chief interest—the play interest—of children. Nothing is presented in this course which has not previously been actually made by children in a school workshop. It is not an entirely "wooden" scheme, and other materials come in as required.

Different Ways of Using the Course.—The scheme may be adopted as a complete course of instruction, or selections may be taken from it and incorporated in other schemes. It may be worked individually, or by communal effort, especially in the making of a complete games-set, as for football and cricket.

It is assumed that the course will be taught in a manual workshop, but it does not follow from this that nothing could be done with it under less favourable circumstances: a "light woodwork" class could well manage some of the models, and other models still could be adapted and modified. It is very desirable that pupils who have the conveniences for it should

work out some of the models at home. A satisfactory piece of homework is the finest proof of what the school has done for the boy.

The Models.—The comments on each model have been given with brevity; first, because many of the models are somewhat familiar objects, and second, because it is hoped that the diagrams will prove almost self-explanatory. The tools required are specified only as they are introduced for the first time into the course. In view of the varying abilities of children, and also of the manner in which the abilities of each child vary from time to time, it would be advisable often to let the children familiarise themselves with a strange tool and practise a new operation on a piece of spare wood, thus largely obviating disaster to their work and risk to themselves. It is urged strongly that the first uses of all tools by the pupils, and especially of the chisel and gouge, shall be preceded by exact demonstration, followed by close supervision, on the part of the teacher.

In conclusion, the authors wish to make it clear that it would have been an easier task for them to give three times the number of models than the number they have given. This fact, in itself, goes to prove of what a rich content such a course is eventually capable. If the course which now follows does but enable teachers to make a good start, it will have achieved its purpose.

1. A MARBLE BOARD.—This is to stand on a table or the playground, etc., for children to bowl marbles at, numbers over the holes giving points for game.

Tools required.—Jack plane, gauge, try square, rule, marking knife, brace and bit, tenon saw.

Material required.—Yellow deal (Northern pine).

Construction.—Plane wood to size. Mark centre pencil line for holes. Mark centres with gauge. Bore holes with centre-bit. Square over lines and saw out waste. Mark and saw chamfers. Number holes and make numbers indelible by going over them with a pointed punch, which can be made from a long French nail.

Remarks.—Thick wood is chosen for this model as being most suitable to all the necessities of a first planing lesson. The order of planing should be observed as follows: 1. Plane face; test by

touch, sight, and straight edge; put on face mark. 2. Plane face-edge; test by touch, sight, straight edge and try square; put on face-edge mark. 3. Gauge to width on face; plane to gauge line, and test. 4. Gauge to thickness on both edges; plane to gauge lines, and test.

The number and sizes of the holes could be varied according to the wishes of the pupils. This model might well be painted, if possible.

2. BOX FOR MARBLES.—A plain handy box to be used, not for marbles alone, but for any little oddments that need safe keeping.

New Tools required.—Handsaw, hammer, bradawl, nail punch, shuting board.

Materials required.—Yellow deal; 1¼-in. and ¾-in. brads; glue for angle blocks, if desired; leather and tin for hinges if needed.

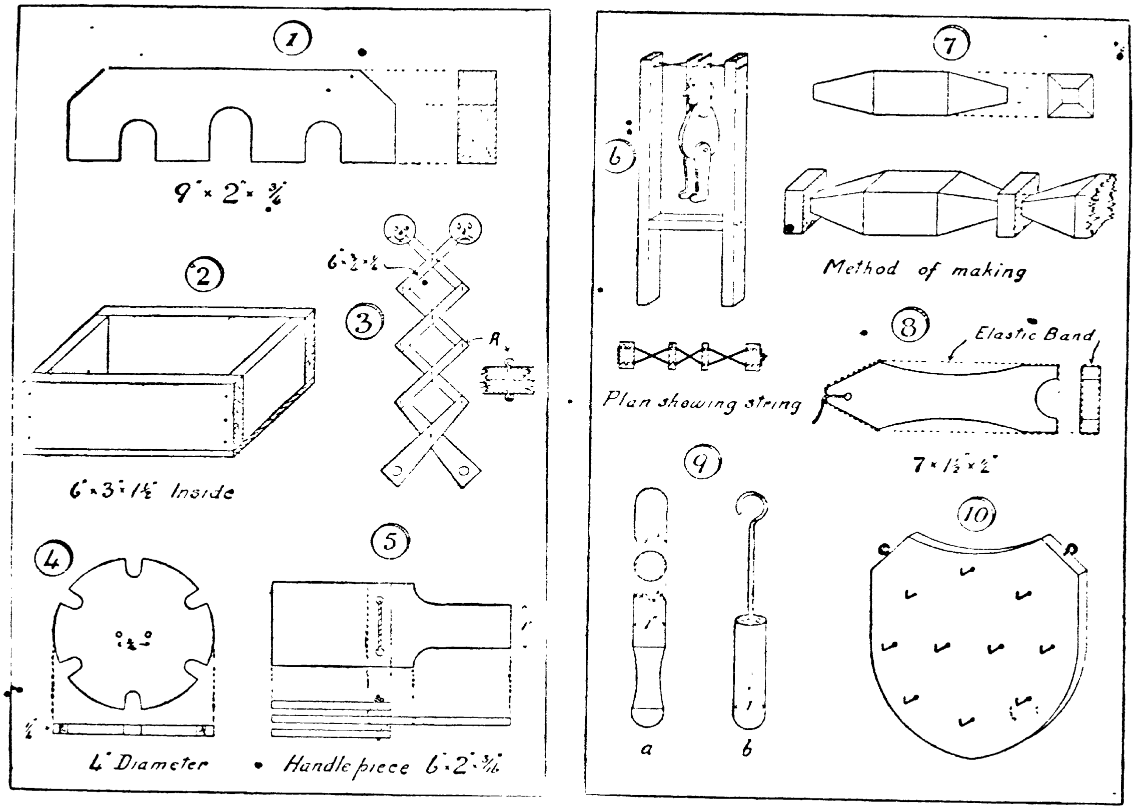
Construction.—Saw out from board two pieces, each long enough to make one side and one end of box. In planing same, the need for accuracy can be well inculcated by the frequent bringing together of the surfaces of each piece, thus proving the truth, or otherwise, of the planing. Mark off ¼ in. waste each end; mark lengths of sides and ends. Bore nail holes. Saw $\frac{1}{16}$ in. from cut line and shute to line. Compare lengths, and nail together, taking care to punch nails $\frac{1}{16}$ in. below surface. Saw out bottom ¼ in. wider and longer than over-all dimensions of box; plane same, nail on, and shute off waste. The lid may fit either the inside or outside dimensions. It may rest, if inside, on glued angle fillets or slender cross fillets glued to ends. Sketches show nail or piece of tin used as a hinge: leather strips could also be used. A screw ring, as used for pictures, would make a suitable means of lifting lid. The painting of the box would make a satisfactory finish.

3. TRELLIS TOY.—An amusing embodiment of certain mechanical forces.

New Tools required.—Disc-cutter or expanding bit; round-nosed wire pliers, as used by milliners.

Materials required.—Basswood; ⅝-in. flat-headed round brads, or fine wire.

Construction.—Cut strips from $\frac{5}{16}$ in. board with cutting gauge, or marking gauge can be made to do. Plane strips, shuting


1
9" × 2" × 3/16
2
6" × 3" × 1½" Inside
3
6" × ½" × ¼
A
4
4" Diameter
¼
5
Handle piece 6" × 2" × 3/16
6
Plan showing string
7
Method of making
8
Elastic Band
7 × 1½ × ½"
9
a
b
10

Figs 1 to 10.

edges on board. Mark lengths, comparing same. Diminish handles on shuting board. Bore holes for grip. Bore fine holes for hinges (wire or nails). Cut discs for heads and paint features with varying expressions. In fixing together, wire hinges could be looped at each end or nail riveted on hammer head. Paint or stain toy as desired.

4. HUMMING WHEEL.—This toy is revolved by pulling to and fro the twisted string, and is extremely well known by juveniles, who usually rely on a big button to do the humming.

New Tools required.—Bow saw and spokeshave, if a disc-cutter is not obtainable.

Materials required.—Birch or sycamore; whipcord or string.

Construction.—As a short piece is difficult for a beginner to plane, smooth-sawn wood might be selected and a smoothing plane used. Bore fine holes for string to pass through, and holes for the outer shapes. Saw or cut to circular shape. String should be fine and strong, and at least two feet long when doubled.

5. CLAPPERS.—*New Tool required.*—Small "G" cramps.

Materials required.—Birch, beech, or other hard wood; stout string for hinge.

Construction.—Saw and prepare strip long enough to form three pieces; mark lengths; shape handle by boring holes and sawing from end to same. Waste pieces form divisions at hinge. Use file to finish off handle. Hold assembled parts by "G" cramps to prevent shifting when boring holes with pin-bit for string hinge.

6. THE GYMNAST. *New Tool required.*—Fret saw.

Materials required.—Yellow deal and some hard wood (three-ply wood very suitable).

Construction.—Prepare frame from yellow deal, cut out figure with fret saw, and hinge limbs loosely with wire as in the trellis toy; bore holes in hands; insert catgut or string, which should cross between the hands.

This figure performs amusing acrobatic feats when the lower ends of the frame are pressed towards each other. Paint figure and framework in appropriate colours.

7. A TIP-CAT. *New Tool required.*—Chisel.

Material required.—Straight-grained soft yellow deal.

Construction.—Saw piece two inches longer than required tip-cat ; plane to square prism ; mark length with cut line, and pencil lines where slopes begin. Gauge lines for depth of sawing ; saw to lines, and pare slopes with a 1-in. or wider chisel, taking care to have wood firmly secured in vice. The inch-pieces at each end act as buffers, thus insuring safe manipulation of the chisel. Saw off buffers when paring is completed. Exact previous demonstration and strict after supervision by the teacher are essential in the first use of the chisel by pupils.

8. A WHIZZER.—This toy, being whirled round at the end of a long string, the elastic band produces a musical note.

New Tools required.—None.

Material required.—Some heavy hard wood, such as oak or birch.

Construction.—Shute sloping ends ; bow saw and spokeshave hollows ; bore holes at ends before sawing off waste ; saw $\frac{1}{16}$ in. from line, and pare vertically to line with chisel. Bore small hole for string, which should also secure rubber band.

9. HOOPSTICK AND SKIMMER. *Material Required.*—Yellow deal.

Construction.—Prepare square prism ; convert to octagonal prism, and gradually bring to cylindrical shape by use of plane (using simple cradle fixed in vice), finishing off with file and glasspaper. The handle of the skimmer might be left octagonal, and the end rounded with a file. Bend piece of malleable wire to shape and file a sharp point on the handle end. Bore hole in handle with fine pin-bit, place skimmer in vice, and drive handle on with smart blows by mallet. Hoopstick to be shaped with spokeshave at one end to suit grip of hand, and dubbed off round with file at both ends.

10. A RING BOARD.—Rings are thrown at the numbered hooks on the board in competition for the highest score ; the same number of rings being used as hooks on board.

Materials required.—Yellow deal or basswood ; small cup hooks or bent wire brads.

Construction.—This model admits of individual design in obtaining variations in outline and positions of hooks, and it forms a good bowsawing and spokeshaving exercise. The board can

hang on holes bored in it, or, better still, depend from screw eyes. Brads placed in an iron vice and bent over to a right angle by hammer taps may be used instead of cuphooks. Old brass curtain rings would be suitable for missiles; or wire could be bent to shape; or rings could be cut with disc-cutter from three-ply wood; or rings can be purchased at a toy shop.

11. TEE-TO-TUM. For choosing sides in games, or as a game in itself if numbers are substituted for colours.

New Tool required.—Metal file.

Materials required.—Sycamore for wheel and knob; basswood for case; little piece of brass for indicator.

Construction.—Case as box in Model 2. Wheel cut as in Models 3 and 4. File brass for pointer, or use bent nail. Diagram shows flat-headed nail passing through base block, which is fixed to bottom of box; at top end it should be filed slightly rounding, and the hard wood block which is used to turn wheel takes the wear at the bearing. Indicator to be fixed on angle block in corner of case. The wheel should be painted in two colours.

12. VARIOUS BATS.—1. Simple battledore (not in diagram) similar in shape to the table-tennis bat, but of uniform thickness, say ⅜ in., and 12 in. long. 2. Table-tennis bat. 3. Rounders bat. 4. Rounders stick.

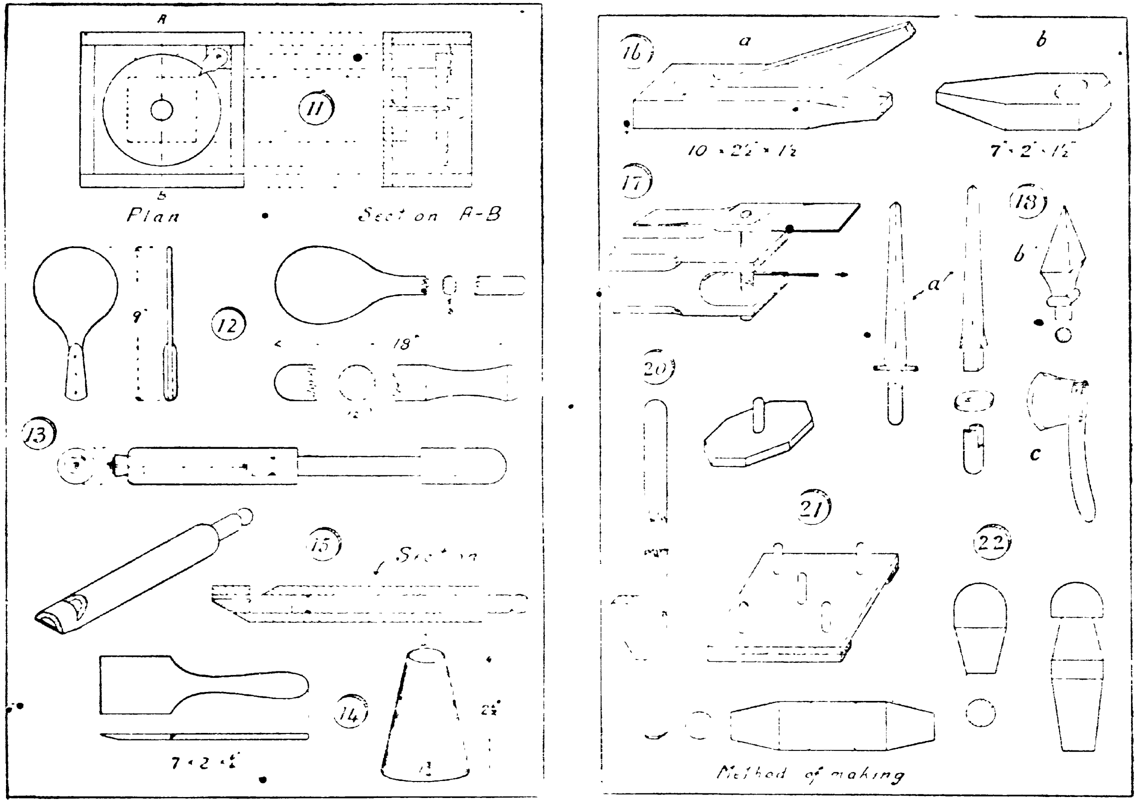
Materials required.—(1) Sycamore, beech, or other hard wood; (2) Thin blade of hard wood, with softer wood, such as cedar, glued on to form handle; (3 and 4) Yellow deal or basswood.

Construction.—All three bats to be bowsawn and spokeshaved. Rounders stick prepared as hoopstick (Model 9). Before gluing on strips for handle of tennis-bat, warm them, and secure till dry by small "G cramps." Finish off handle with spokeshave, file, and glasspaper. Holes could be bored in ends to hang bats up by. Varnish or polish as desired.

13. POP-GUN.—A very old toy, well illustrating the force of compressed air.

New Tools required.—Twist-bit and little metal block plane (as sold at about 6*d*).

Materials required.—American pine or yellow deal; dowel rod (if procurable) for plunger; suitable cork; wool, thread, or fine string for packing; some lubricant, such as tallow, for



FIGS. 11 TO 22

plunger; little screw-eye, bent nail, or wire for loop on end of plunger; piece of tin for washer on outer end of cork projectile.

Construction.—Bore hole in rough piece, which should be thick and wide enough to allow for possible deviation of bit, and long enough to make handle of plunger and barrel of gun. With hole as centre, mark a square on each end of wood; plane to square prism and convert to cylindrical shape; saw off handle piece; prepare plunger from dowel rod or from piece of rough wood, in this latter case using little metal plane with one hand, holding end of plunger in other hand, and resting strip on bench. Glue handle on plunger; round ends with file and glasspaper; form on interior end of plunger a little channel for the packing which retains air in chamber. Fix loop on end of plunger, secure string to same, pass string through hole in cork, tie knot outside small tin-washer, and then begin popping.

14. "STEADY, BOYS, STEADY."—A table game for two or more players, inculcating skill in balancing a marble on a spade in its passage to the cardboard "home" or container. One spade and one container are allotted to each player, and each set is coloured differently. Equal numbers of marbles are taken by each player, and he who gets his "home" first wins.

Materials required.—Hard wood for spade; cardboard and paper for container.

Construction.—Shape spade with bow saw, spokeshave, file, and glasspaper; bevel underside of front edge with little block plane held slantwise. Plot out development of container (truncated cone) on cardboard; cut to shape and join up, covering the whole with stout paper. There is no top or bottom to the container. The upper orifice should be only very slightly larger than marbles.

15. WHISTLE.—On this instrument simple tunes may be played.

Material required.—American pine or yellow deal.

Construction.—Prepare barrel and plunger as in Model 13, allowing plunger piece long enough to leave short end for mouthpiece. Cut escapement with saw and pare with chisel. Saw off small portion from plunger piece, plane a small flat surface on same for passage of air, glue in required position; after glue

hardens, finish shaping mouthpiece. Use beeswax to finish off exterior of whistle.

By manipulating the plunger a range of musical notes (more or less) can be obtained.

16. BALL-TRAP.—A simple and a more difficult form of ball-trap are both shown. A smart tap with a stick or bat projects a ball into the air, which is subsequently struck (or missed) by the player.

Materials required.—Hard wood preferable, but deal would answer for body of trap; screw, dowel, or stout wire for pivot.

Construction.—For simple trap, prepare wood, bore hole, saw and plane diminishing end.

For the more difficult trap, bore hole, saw to gauge line for slot or groove, then with mallet and chisel remove waste, finishing bottom of slot with chisel only; shape curved end with bow saw, spokeshave, and file. Prepare and fix lever to work easily on pivot. Varnish or paint trap.

17. FLYER, WITH HOLDER FOR SPINNING.—The holder gives the operator greater facility in generating force and launching flyer in air.

Materials required.—Cedar or yellow pine for flyer: yellow deal for holder.

Construction.—Plane block to square prism; bore hole for stem of flyer; next bore hole for slot, saw out waste; chamfer or otherwise decorate handle. Prepare rod of flyer as plunger in Models 13 and 15. To get with ease the proper shape of propeller blades, fix the thin pieces with a nail or screw through stem hole on to a piece of wood, place the whole in vice, and shape blades with spokeshave. A light woodwork or pocket knife might be used instead of spokeshave. If more than two blades are desired a cross-halving joint must be used at centre.

18. SWORDS, ETC.—For school play, pageants, and so forth.

Material required.—Pine or basswood.

Construction.—The simplest form for a sword or dagger is the cross-hilt halved into the blade. A good form of sword is given. Form shoulder on blade, which should previously have been shaped, and which passes through mortise in hilt, and into a slot in handle; the whole to be glued and screwed or pinned. The

construction of the axe is sufficiently shown in diagram; the head could be secured to the handle by wooden pins. Spear heads can be carved out of the solid, provided they are formed on the end of a longer piece of wood so as to be safely wrought out. Shields, helmets, and other paraphernalia of war are usually made from cardboard, and educational magazines are rather fond of dishing up such things in connection with dramatised history.

19. BUILDING BLOCKS.—No child disdains a game of building. Blocks of various dimensions and shapes can be sawn from carefully prepared lengths, glasspaper being used to remove roughnesses. It would be very interesting and profitable if ordinary bricks were reproduced to scale and used for wall building. The English and Flemish and other "bonds" would not be too much for even a child to attempt, nor the need for such "bonds" too difficult to understand. Besides blocks, simple door and window openings, etc., might be easily constructed. This model is not illustrated amongst the diagrams.

20. STILTS.—*Materials required.*—Yellow deal; harder wood for steps.

Construction.—Length of stilts and height of steps from ground to be determined by measuring the boy who is to be elongated. With spokeshave shape handles on upper ends. Let in slightly lower part of steps as shown in diagram; screw parts strongly together.

21. QUOITS. *Materials required.*—Yellow deal for base; with hard wood pegs.

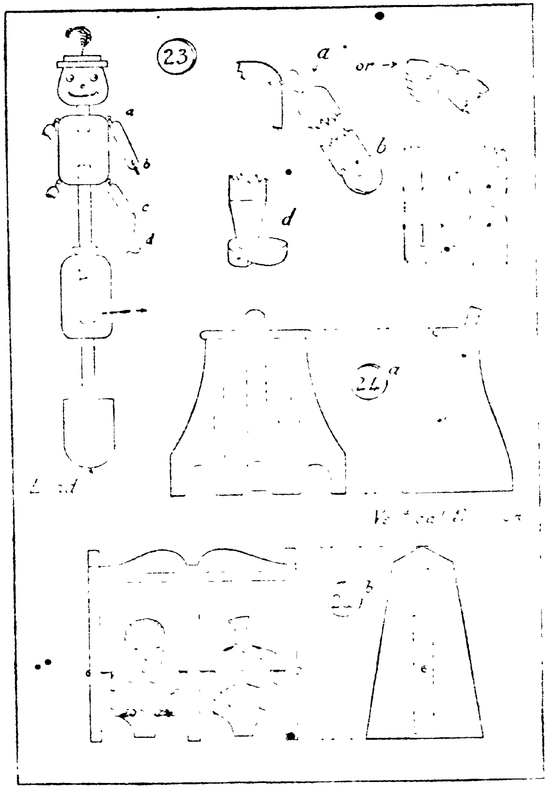
Construction.—Size and shape of base as desired. One or five pegs are used as shown, and are fixed in holes bored in base. Base could be kept from splitting or warping by screwing on small battens. Quoits could be cut out of three-ply wood, and bound round with some textile material.

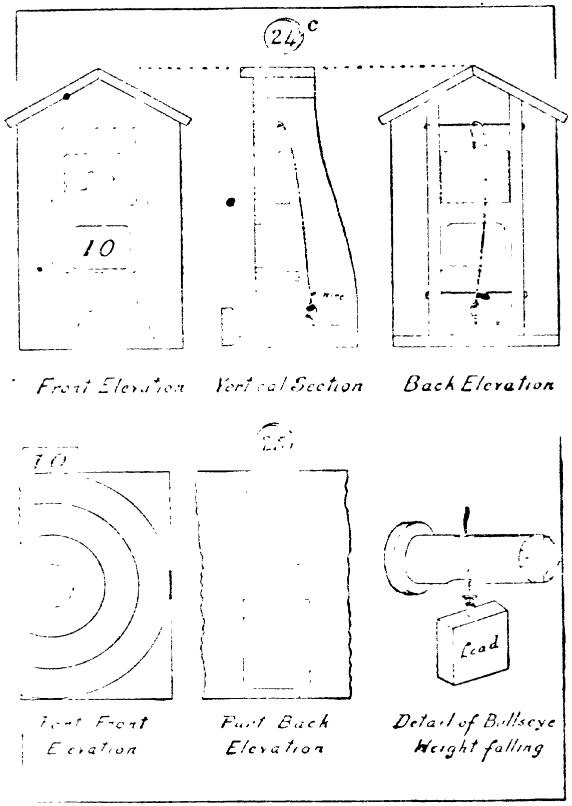
22. SKITTLES AND NINEPINS.—Those given may be worked without a lathe, but where a lathe is available these make a good turning exercise.

New Tool required.—Drawshave or draw knife.

Material required.—Yellow deal or oak for skittles.

Construction.—Shape solid cylinder as described in Model 9,


23
a
b
c
d
a
or →
b
d
24 a
24 b


24 c
10
wire
Front Elevation
Vertical Section
Back Elevation
25
10
Lead
Part Front Elevation
Part Back Elevation
Detail of Bullseye Weight falling

which should be long enough for two skittles or ninepins. Draw base circle on each squared end; remove waste to form taper by drawshave, finishing with smoothing plane. If for skittles, saw apart, and round top with spokeshave, file, and glasspaper. If for ninepins, put sawkerf round to depth required, pare slanting portion as in Model 7; saw apart, and finish as in skittle. Ten skittles or ninepins will be made thus, allowing an odd one for breakages. Ninepins might be picked out in two or three colours.

23. SPINNING FIGURE.—The holder being grasped in one hand and the string given a reciprocal motion as in Model 4, the figure revolves and its arms and legs move out laterally as do the balls of an engine-governor.

Materials required.—Satin walnut, birch, or chestnut; fine wire.

Construction.—Prepare 1¼-in. cylinder, long enough to form head, body, holder, and balance, and saw to required lengths. Facial features to be painted or incised, or formed by small black nails; beads for eyes would give alert expression. Hat formed from two discs secured by glue and nail in centre. Prepare ¼-in. cylinder, or obtain dowel rod, to make pivots, etc.; bore head, body, holder, and balance to take pivot rod, allowing a hole of slightly larger dimensions for the bearing. Bore larger hole for string to emerge from; secure string to pivot rod. Prevent shaft dropping by glueing a small piece of hard wood above holder, so as to take weight; round this to cup-shape on underside, thus obviating too much friction. Prepare ½-in. cylinder for limbs, saw lengths, secure at joints with wire hinges as in enlarged sketch. The weight at the balance must be adjusted to preserve centre of gravity of figure above: a small amount of lead, which could be pared down to suit, would answer.

24. MARBLE TARGETS AND "TRAINERS"—These are really developments of Model 1, and simple means of training in marksmanship.

Materials required.—Any available wood, small piece of wire; a few brads.

Construction.—No. 24A. Small rubber ball or large marble on top bar is dislodged by pivoted lever, when struck by marble at base. Front admits of variation in outline and decoration

of blank spaces. Construction may be easily followed from diagram.

No. 24B. A marble striking either of the pivoted figures causes them to turn one or more somersaults. Sufficient room should be allowed on each side of the base of each figure to let a badly aimed marble pass. The figures should be sufficiently heavy below pivot to keep them in normal positions. They could be infinitely varied, and could be painted or pasted over with coloured paper according to the figure's characteristics.

No. 24C. Bullseye, when struck by marble, is driven inwards; string comes off bent wire and allows number board to drop, so that number appears at opening. The front of this model admits of much variation.

25. TARGET WITH INDICATING BULLSEYE. To be used with gun firing some kind of missile (rubber-ended by preference).

Materials required.—Any straight-grained wood; reel for bullseye; lead for weight.

Construction.—Prepare board; describe circles; bore hole size of body of reel, and fix cleats or stiffening pieces on back, which should be deep enough to keep mechanism clear of wall. Saw one flange off reel, and make slots as shown in sketch to allow working of screw-head and string. String is fastened to indicator (which is made of tin or cardboard), passes over bar, through slot in reel, is fastened to head of screw, which screw is turned into lead weight, which slides in runners. Bullseye being struck and driven inwards allows screw to drop out of reel at hole, lead weight falls, and this raises indicator. The circular bands should be fittingly painted.

26. CLOG DANCER.—The person working the figure sits on one end of the spring-board, and holding the rod by one hand on which the figure is fastened, with the other hand, by a series of graduated blows, imparts a vibratory motion to the board. This, together with the manipulation of the figure by means of the rod, gives an excellent imitation of a clog-dancer.

Materials required.—Figure of some hard wood; spring-board and rod of ash; wire.

Construction.—This can be easily followed from diagram. Note that the clogs are very loosely pivoted to ends of legs. The

figure might be made an imitation of soldier, sailor, tinker, tailor, or anything else in human semblance, and painted accordingly.

27. Jumping Posts.—Two methods are here given of holding up a string at desired heights. At each end of the string should be a light weight to keep string from sagging.

Material required.—Yellow deal.

Construction. Prepare base, making half-lap joint at cross. End of posts should be tenoned to go in centre square mortices. Top of posts "weathered" or sloped. Shaped pieces should be nailed, screwed, or dowelled to post and base, acting as angle stays. Holes can be bored for pegs, or notches pared.

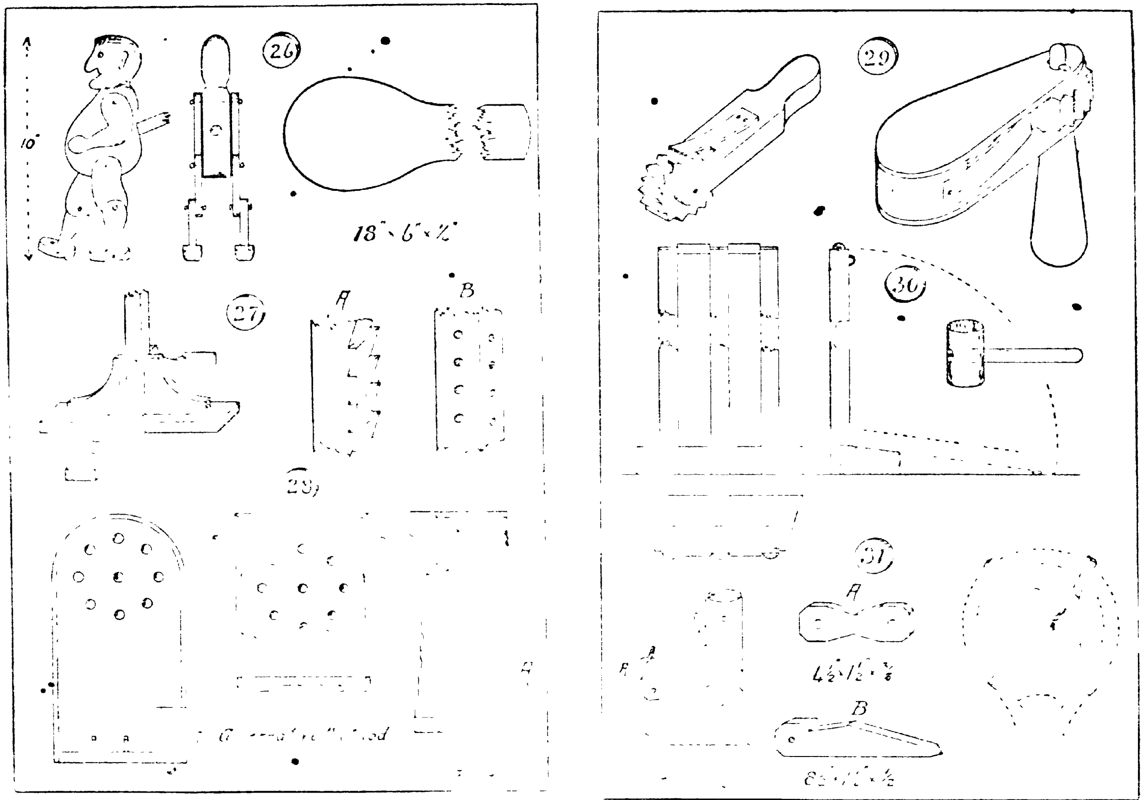
28. Bagatelle Boards.—Two varieties are shown; in one a cue is used, in the other a spring gives the impulse. A width not less than 9 in. nor more than 12 in. will give suitable proportions: length to some extent being determined by width.

Materials required.—Deal or basswood; wire for spring.

Construction. Prepare and shape board for base. Prepare ¼-in. strip for rim, rounding one edge, and bend by previously steaming or applying hot water with large glue brush. Let strip be long enough to go round end and sides of base, and to project over at square end. Fix strip with brass pins or screws. Prepare and fix square endpiece, and then saw off projecting ends of bent rim. Corners can be strengthened by angle strips of tin or brass. Holes can be bored with ¾-in. centrebit, and lined at bottom with disc of coloured paper, or scooped out with firmer gouge. Partitions of small compartments to be glued and nailed. Spring box is shown enlarged. Wire coil can be bent round a cylinder, such as a lead pencil. The end formed by segmental pieces is more easily made than the end with bent wood.

29. Corncrake and Watchman's Rattle. *Materials required.* For wheels, birch or beech; for tongues, ash; for other parts, deal or any such wood; wire for linch-pin or pivot.

Construction. Tin pattern might be cut for serrations or cogs of wheels. Mark with awl or knife round pattern, place wheel in vice, square pencil lines over edge, saw angles carefully with dovetail saw, first sawing all lines on left of saw, and then reversing wheel to bring other lines on left. If any roughnesses remain finish lightly with saw file and glasspaper. The other construction



Figs. 26 to 31.

can be followed from diagram. In making rattle, prepare handle as separate piece, and bore hole in smaller end, in which dowel rod is secured by glue to act as axle of wheel; fix wheel tightly on axle by glue and fine pin. Solid block at end of rattle gives weight and good hold for tongue, which ought to be let in flush and well screwed. Top piece should go on after wheel is secured to axle, and linch pin keeps all compact.

30. CRICKET SET.—A solid wooden bat could be easily made by any boy at this stage of the course, but the absence of a splice would materially affect the comfort and efficiency of the batsman. Score boards might consist of plain pieces of wood to hang up with nails, or hooks from which to suspend tin or wood number plates. The score board could also be mounted on a post constructed exactly like jumping posts, but of stouter dimensions. Bails will be prepared from cylindrical stuff, which will be bored for dowel rod to act as rests on top of stumps. The wood used for stumps should be ash, and if for playing game in field the ordinary pattern will serve. The set illustrated is intended for playground use. The base block is of oak or birch, and hollowed on front to receive half-circumference of stumps; it is cut away so as not to extend the frontage of the wicket. Each stump is hinged separately by what is known as a back-flap hinge, and falls over on to a rubber stud; the base block being bevelled on top so as to allow stump to touch ground. The mallets would be most useful for field use, and fairly easy to make, if hole was bored through head, and handle wedged on. Even the ordinary carpenter's mallet would not be difficult to make.

31. TENNIS POSTS AND ACCESSORIES.—*Materials required.*—Any available wood; $\frac{1}{4}$-in. to $\frac{1}{2}$-in. iron rod; metal or wood for cleat. Hard wood for pegs and runners.

Construction.—Plane posts octagonal or cylindrical. Make gouged hollow or shallow groove for cord on top of posts. Bore hole at other end for iron rod to drive tightly in; end of rod should be pointed so as to penetrate ground. Cleat can be shaped from wood or metal, and screwed on to post. Pegs and runners to be wrought out as shown in diagram. An excellent racket press is also illustrated, consisting of a pair of clamps, each comprising two pieces jointed together by means of

lapped-halving; bolt and thumb screw to give necessary compression.

32. Stool Ball Set. –This game has been described as the rudimentary form of cricket, and it has been revived in recent years. The wicket consists of a board screwed on to a post, which is shaped at the other end to enter ground; or if to be used in playground, a base as for jumping posts or score board can be substituted. The shaping of the bat is indicated by sections in diagram. Wicket could be made of deal; and bat of a tough wood not too heavy.

33. Croquet Set. –*Materials required.* Beech or oak for head, and ash for handle of mallets; iron and wire for arches or hoops.

Construction.—Prepare cylinder long enough for the number of mallets required. Bore hole in head, and glue and wedge it on to handle. A saw kerf should previously be made in end of handle to receive wedge, which is driven home by hammer. The hoops, made of ¼-in. to ½-in. round iron, may be bent to shape over a piece of hard wood as thick as inner width of hoop. Ends to be sharpened, and a piece of wire secured 12 in. from top to keep arch at proper height above ground level and to keep opening parallel. The pegs used in this game are easy to make, and should be coloured according to rules of game, for which consult any Cyclopædia.

34. Toboggan. *Materials required.*–Yellow deal; hoop iron for edge of runners.

Construction.—Prepare sides; screw on supports for foot rest; bore holes for rope. Saw off bearers and nail sides to same, or, better still, notch or tenon them in (all three methods appear in diagram); nail on platform. Start nailing hoop iron at point A, and beat to shape along the whole edge, nailing as you go, to point B, just under back board.

35. Boats, etc.—A large field of effort is opened up here, which can be worked over to any desired extent by consulting books of reference, periodicals which cater for the boys—such as *The Scout*—and the boys themselves. One example only is given, such as may be made by any ordinary boy. It is, as it were, the type model, from which more ambitious constructions may be evolved.

Materials required.—Yellow pine; lead for keel.

Construction.—The outline as shown in plan is to be marked on top surface of block, and worked out at right angles to the top and bottom with bow saw, chisel, and spokeshave. Mark on both sides of boat the lines shown in elevation. Mark lines showing stern elevation. Cut out stern with tenon saw and chisel. Mark lines of keel, and model off sides to keel with gouge, chisel, spokeshave, and file. Finish off with glasspaper.

36. PORCH SWING.—A very safe and easily made swing for a young child, which can be used in any convenient doorway.

Material required.—Hard wood for the whole if procurable, and in any case hard wood for top frames.

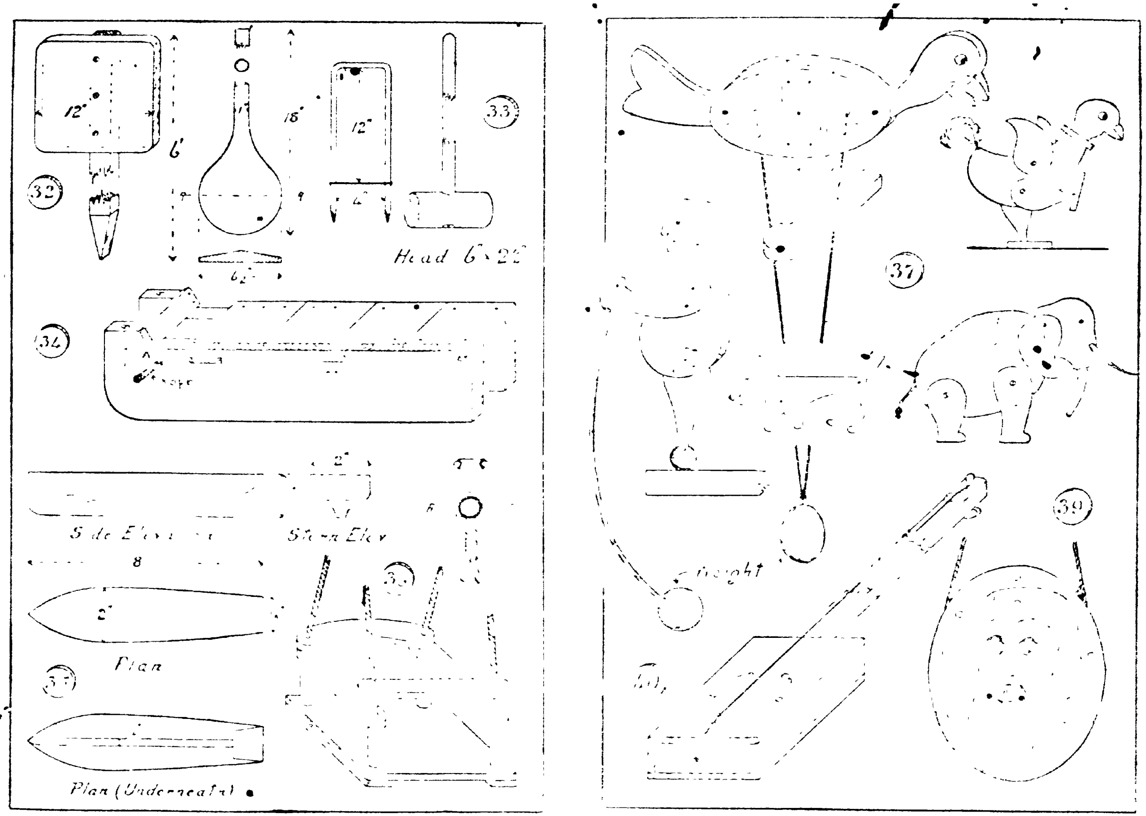
Construction.—Screw battens or ledges on to seat; bore holes for cords through both pieces. Prepare cylinder long enough for four pillars, saw apart, and make bore for cord with twist-bit. Prepare shaped top framing as shown in diagram. The cords are knotted under seat, and passing through other parts are suspended from stout screw-hooks fixed in lintel of doorway. These hooks should be of the safety kind procurable at ironmongers'. At the top of the cords, eyes should be formed round a hollow-edged metal ring as shown in diagram.

37. MOVING ANIMALS AND FIGURES.—Great variety is possible in this connection. *The Material* should be a wood of even grain, and not too hard. *The Construction* may be followed easily from the diagrams, and should be carried out largely with fret saw, bow saw, spokeshave, and file. The balancing and pendulum motions should present no difficulties.

38. WOODEN PUZZLES.—The number of these is wellnigh legion. A few only are given as typical puzzles.

(*a*) *Box Puzzle.*—A number of square blocks bearing consecutive numbers are arranged in a box. In No. 1 on the diagram, the blocks have to be re-arranged in correct sequence by sliding, using vacant space. Nos. 2 and 3. Arrange blocks so that total of numbers, either horizontal, vertical, or diagonal, shall amount to twelve in case of 2 and fifteen in 3. Method of preparing blocks for convenience of manipulation is shown.

(*b*) *Peg and Disc* consists of slab with three pegs, and four discs (X) of regularly increasing diameters arranged on first peg,



12"
6'
18"
12"
4"
Head 6 x 2½
6½
2"
Side Elev
Stern Elev
8
2"
Plan
Plan (Underneath)
Weight

FIGS. 32 TO 40.

largest disc at bottom. The discs have to be transferred from first to third peg, transposing only one disc at a time, and placing it either on a vacant peg or on a larger disc.

(*c*) *Right and Left Puzzle.*—Strip of wood, 7 in. long, marked into squares and fixed upon wider base, a peg or brass pin projecting at centre of squares. Six discs (three of one colour and three of another) arranged as at X X. Puzzle is to transpose the red and black discs, so that the three red shall occupy the places of the three black, according to the following conditions: (1) Each disc can be moved only one space at a time; (2) If a disc is divided from a vacant space by a single disc only, it may pass over it into vacant space; (3) Disc only moved in a forward direction. A move cannot be retracted.

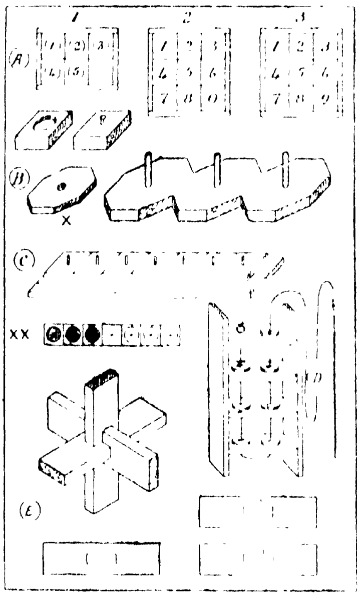


FIG. 38

(*d*) *Chinese Ladder.*—A small ladder of four steps, each step having two holes in it. A fine cord or strong thread, a yard long, secured at top by a glass bead, is threaded through each hole in succession (down one side and up the other), and passing through six discs (see diagram); to the free end of string a stout needle is attached. The puzzle is to bring the whole of the discs *together* on the cord.

(*e*) *The Cross Keys or Three-piece Puzzle.*—Consists of three pieces of wood interlocked as in diagram. Separate and then reassemble parts. Working details are shown in diagram.

39. WALL GAME: "PLACING THE PIPE."—The board is hung on the wall, and the players, being blindfolded, attempt to place the pipe in that part of the physiognomy where pipes should go. Much amusement may be derived at a children's party from this. A wide board, or two or more boards jointed, is sawn to any

suitable shape, and strengthened and kept from warping by affixing two hard wood strips on back. The board should be painted one colour, and then some suitable head painted on it in another colour. Next bore holes, taking care to have a hole in each eye, each ear, tip of nose, chin, and middle and both corners of mouth, with other holes *ad lib.* A penny wooden pipe previously procured would determine size of holes.

40. ONE-STRING OR JAPANESE FIDDLE.—Make stem of sycamore or walnut, box of cedar or pine (resonant woods). If possible, use no nails or screws, as these would affect tone, but rely on glue and a good fit, strengthening corners inside with angle blocks. Stem must have a shallow notch taken out to thickness of sound board, so as to maintain common level of stem and box, and should be rounded as shown: the projecting end to have a fine saw kerf to receive string. Bore and shape sound holes; finishing with file. Secure glued joints by "G" cramps and allow to dry thoroughly. (N.B.—Freshly glued articles should always stand by for at least twelve hours.) Carefully clean off with fine-set smoothing plane; glass paper; and use good varnish.

Addenda.—A few suggestions for other toys and games are given. Toys for young sisters: see-saw, swing, and merry-go-round for dolls. For young brothers: wooden engine, trolley, wheelbarrow, etc. Tape-ladder puzzle. Kite string winders. Dominoes and draughts: usual size, or very large sized for floor games. Light Indian clubs and dumb-bells. Football set: goal posts, boundary sticks, pegs, and runners. Gliders. Kites. Aeroplanes. Cribbage board and pegs. Tumbling tablet. Smoke-ring box. Wrestling clothes-peg men, as seen sometimes at street corners.

BOOKS FOR REFERENCE

Hoffmann's Puzzles, Old and New, *Gliders and Aeroplanes* (Percival Marshall), *Coping Saw Work and Kite Construction* (Manual Arts Press, Peoria, Ill.); *Easy Woodwork* (Newman & Co), *Every Little Boy's Book* (Routledge); *Boy's Book of Boats* (Sampson Low), *Science in the Nursery, or Children's Toys* (Griffith, Farran).

XXXV. CLAY MODELLING FOR JUNIOR CLASSES

By John Young

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Special Aims in the Junior Class.—Practice in the necessarily formal exercises in the Kindergarten work will have made the children familiar with the general plastic qualities of clay. They will understand such operations as "breaking from the supply," "rolling," "smoothing surfaces with the moist finger," and the methods of keeping the clay in good condition while at work. It may be necessary from time to time to remind them of the necessity for absolute cleanliness in their work. Clean fingers, clean tools, and a clean place at table are essential, as the best work is possible only when these conditions prevail.

It must now be understood, however, that the chief aim is the development of skill and accuracy of result in the exercises. It will not be sufficient to make the effort to do things from memory, or from an idea, the scholar must be led to test and criticise every effort, and compare very carefully with the actual model placed side by side with his work. A conscientious attempt must be made to faithfully imitate the form of some object given out for study. As this must be an all-round imitation, it means more than merely seeing the form, its shape and measurement must be seen, felt, and re-created in clay.

Guiding Principles.—It must be a recognised principle all through the course, that the main object of the work is to enable the children to *see* and recognise the *truth* which is *beauty*, and the beauty which is truth, in everything around them. Practice should enable them to state the truth intelligently in all they do, so that others again may see and recognise it in their work. Above all, each lesson must teach *method, forethought,* and *plan-*

ning. The great need with young children is to begin to develop forethought in their work, to get them to look before they leap, to avoid mere muddling through and finding out when it is too late that the whole of their effort is wasted. A teacher should refuse to accept work from children which he may think is not their best effort at the moment, and he should always take as the measure of success—how much of the truth has been put into the work.

The value of clay modelling as a subject in school is at least equal to that of any of the other subjects. The laws and principles of its practice are as fixed and reliable, and its results quite as certain. But if the teaching is to be real and fruitful, there must be a sane *method* of practice which is simple, clear, and constant, capable of easy explanation, and which will always apply.

Naturally, every teacher should solve this issue in his own experience, but the essentials of such a method must comprise: (1) *Observation,* for without careful observation no useful knowledge of form can be learned. (2) *Comparison,* as without careful comparison of the forms under observation (with each other and with former impressions) observation is but half done. (3) *Recollection,* since we cannot observe and work at the same time, impressions must be memorised, and related, before we can proceed to (4) *Reproduction,* which may be taken in the following order: (*a*) *Composition, i.e.* settle definitely, before beginning, the scale of the work and its general treatment; (*b*) *Secure the general shape and proportion;* (*c*) *Model the principal details and divisions;* (*d*) *Surface finish.*

When once it is made clear that this is a safe method to follow every time, it only remains for the teacher to warn scholars against the possible exceptions which may occur. At first there will be opportunity for careful and systematic demonstration on the part of the teacher. The children must be shown *how it is done.* This, however, becomes less and less necessary, and the teacher must soon take up the rôle of critic Criticism should be kindly, and praise bestowed whenever it can honestly be awarded.

Use of Pupils' Work.—It would certainly be inadvisable to

preserve all the work done, yet one should exercise caution regarding the destruction of models after a lesson. It is obviously a very discouraging thing for the pupils to see the models upon which they have bestowed an hour's honest work ruthlessly cast back into the bin and destroyed. It is better for this to be done, if at all, when the class has gone (if circumstances will permit); but the best efforts should in all cases be preserved for a time. If this serves no other purpose it will, at least, enable a teacher to make some measure of his progress, and provide him with the best possible record of work done.

Schemes of Work.—The following examples and illustrations may stimulate effort in acquiring a method and technique that will carry a teacher far beyond the course of an elementary school.

No set scheme of lessons is given, for the very good reason that every teacher must make his own scheme. Into it nothing should go which he has not "*sweated*" over, and made his very own by working whole-heartedly through it. It is hard to convince young teachers of this simple truth, but the sooner they recognise the fact and set to work, the sooner will come their own measure of success. They must themselves be the architects of the only scheme that will suit their needs.

There are many things to consider when making a scheme: the time at your disposal, the size and capacity of your class, and the kind of thing you will study, should indicate the aim and scope of your work. The gradation of the exercises should be carefully thought out and planned, so that the advancing steps are easy. Select models as far as possible from the natural surroundings of the child. These should be easy to handle, and occupy space in three dimensions. When artificial objects are chosen, their contour should be of varying curvature and not flat. They should not (to begin with) be too complicated or elaborate, but such as the children may reasonably be expected to tackle and finish within the period of one lesson.

The classes should not be too large, because individual instruction must accompany class teaching and blackboard illustration. It is impossible for one teacher to do both in one hour if the class is too big.

In setting out your scheme, first decide just how far you

think your class can go. Vary the work as much as you can to awaken interest, but if you think the pupils should be confined to the making of round things, with or without a slab, then make out a list of about thirty objects (natural and artificial). Arrange in order of difficulty, to the best of your judgment, then work out each exercise, making notes as you proceed for your own guidance later on. Never take an exercise for granted without this preliminary experiment, or you may wreck a whole week's work. A teacher should at least be sure of himself for the whole of the course he is teaching.

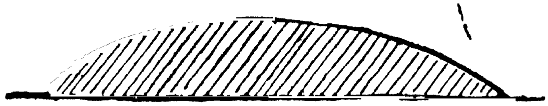
Culture Value.—The culture value of clay modelling is universally recognised by educational experts. Every one readily acknowledges the fact that its practice provides a discipline which trains the power of complete and accurate observation, kindles the imagination, and develops the power of self-expression. The student learns habits of thought and reflection, he is led along the path of original investigation of the wonderful world around him, and finally he makes the attempt at creative effort. Unlike drawing or painting, modelling deals with actual facts, instead of the appearances of these facts merely. As the sense of touch is added to that of sight in modelling, a finer and more intimate knowledge of true form is gained, and a new window is opened to the mind. Through practice, sincerity of observation and judgment are developed, and the power to eliminate trifling details, or to grasp essentials, is stimulated in every effort the child makes. He can only express truly that knowledge of the truth which he has assimilated by observation, therefore his work shows at a glance the extent of his grasp of the form and outward characteristics of the object studied. As Nature and man's handiwork form the chief source of supply for the models, a student's store of useful knowledge is thereby increased in ways that stimulate interest and make him thirst for more.

First Lessons.—These should be more or less a repetition of the fundamental exercises given in the Kindergarten. Naturally, better results will be expected, and a more rigid test of accuracy should be applied. Simple operations, such as the rolling out of balls and worms of clay, might very well form the first few lessons; only as a means to an end, however, and not the end itself. Such

questions as equality or gradation of size and shape would be the real point of the lessons.

An easy variation of this exercise might follow in the making and decorating of small roundels or buttons as shown in Fig. 1.

Form balls, then hollow the palm and press the clay down on to the table until the top surface shows a low dome-shape, rising regularly from a thin neat edge up to the centre, as in the section shown here.



SECTION OF ROUNDEL.

Smooth the top by patting and light touches of the wet thumb or finger; then take a blunt pencil, or a match, and proceed to decorate them by a series of dots or short lines indented lightly on the surface of the clay. Of the examples shown in Fig. 1, Plate XIII, A was decorated entirely with the end of a common match, B with a blunt pencil, while C is the plain roundel without ornament.

The flat surfaces on D were got by gently tapping and pressing the clay with a ruler. E shows a heart-shape, decorated with imprints from a square match end and the two ends of a hexagonal pencil. F was roughly shaped and left to dry; the faucets were then made by rubbing the dry clay on a piece of very fine sandpaper. The three at the bottom show how they appear after glazing and firing.

In this simple and easy way we have the introduction of an artificial tool to assist the work of the fingers. Here also we have the beginnings of design, for the essence of surface design is a harmonious and orderly arrangement of units.

This exercise can easily be developed and other geometric shapes introduced. The simple ones, of course, should be selected: forms with qualities and characteristics which are easily apprehended and understood. Repeated practice will soon develop sufficient skill to enable the children to do these with success. While urging them to do their work as well as possible, a teacher must not expect geometric accuracy in any of the work at this stage.

Fruit Forms.—Having acquired this easy bit of technique, it

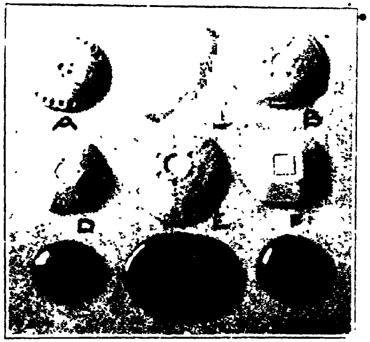


FIG. 1.—SMALL [illegible]

FIG. 2.—TESTING FOR SIZE AND SHAPE

FIG. 3.—[illegible]

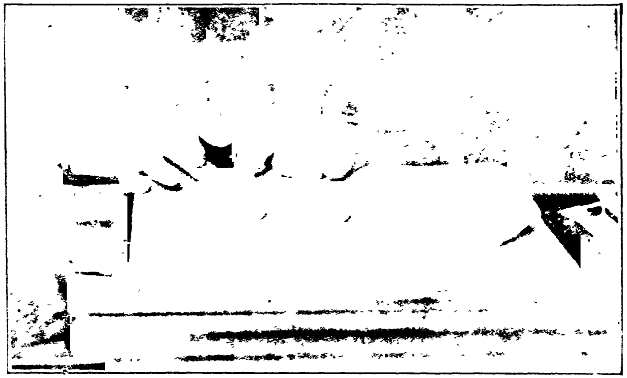


FIG. 4.—MODELLING A [illegible]

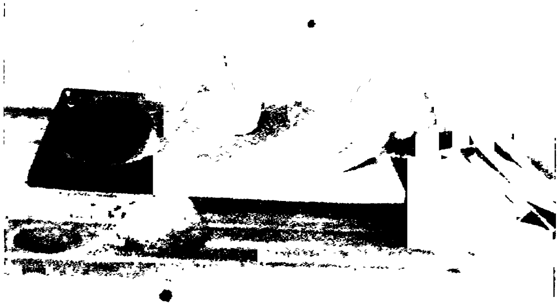


FIG. 5.—A HOLLOW DISH—FIRST STEP
FIG. 7.—A HOLLOW DISH—CLOSING IN TOP

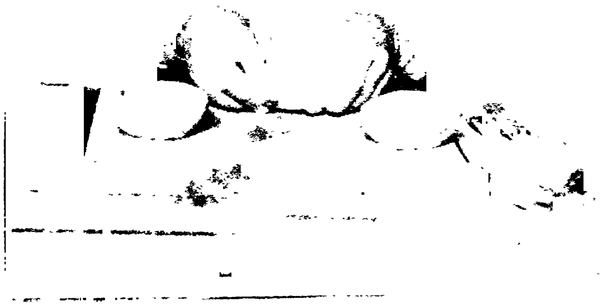


FIG. 6.—A HOLLOW DISH—SECOND STEP
FIG. 8.—GROUP OF DISHES FINISHED AND GLAZED

should now be applied to the direct imitation of natural models. Notwithstanding the infinite variations of form to be met with in Nature, it is evident that many of the most beautiful things are laid out on a geometrical plan, and that quite a lot of the fruit forms are but slight variations of the sphere, though each one has a character all its own. The smaller ones, such as the cherry, gooseberry, apple, plum, etc, make good models for the juniors. Set about doing them in clay by first making a ball, roughly pinch it into shape, and test by comparison with the natural example for size and general shape.

Remember, this testing must be done, not from one position only, but from at least six different view-points. Make the children place the model in one hand and their own work in the other, and compare the outlines (Fig. 2); add or take away clay in order to correct the drawing of this outline. Then turn the model *and* the work one quarter round and repeat. Do this four times for the sides, and once for the top and bottom. If these tests are satisfactorily done, it will be a simple thing to fill in between the corrected lines, and smooth the surface with the moist thumb. Insist upon the necessity for handling the work very carefully. An hour's work can be spoiled in a second by careless handling.

There is an abundance of these forms, all good enough exercises, each involving just the same technique, yet providing ample variety and the necessary small step in advance. Some of the fruits will have stems, or (as in the tomato) a calyx, while others will show surface texture. For the older classes, larger fruits and vegetables may be taken; and if one should run through the whole series, the models can be halved, or cut in any way, when it will be found more difficult to model a large slice of melon than to model the melon itself.

Besides the more common round forms of fruit and vegetables, there are acorns and nuts of all kinds, small shells, such as the mussel, scallop, and limpet, etc. (Fig. 3), and many seed vessels, such as the poppy and iris. All these make splendid examples. At first the younger classes will not bother with a slab, but the same models may very well come in again and again in the course. A lad in the highest class of the juniors will see more in

his model, and be able to put more into his work, than the child who has just left the Kindergarten.

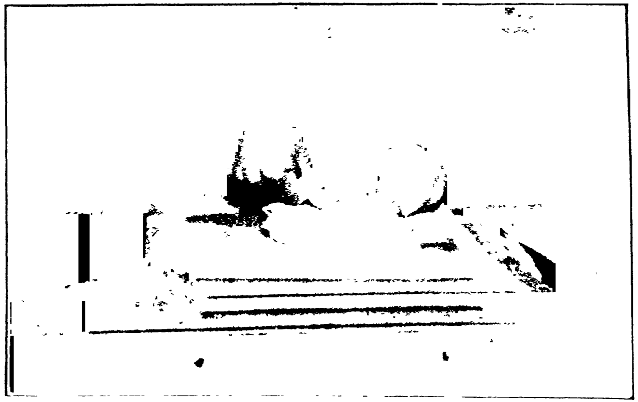
Manufactured Objects. Should it be difficult to procure Nature models at any time, or if a change is desirable, there is another valuable series of exercises available in fashioned things, such as a tube of colour, a paint brush, a cracker, a shoe-horn, a spinning top, a fishing float, a small screwdriver, and otner simple tools (Fig. 4). The list is not anything like complete, but it should be noted that all the models recommended for study are solid objects occupying space in three dimensions. Flat things, such as an envelope, domino, book, picture, fan, or palette, are better left for the drawing lesson, as they do not make good modelling exercises, though they could of course be done. Round things are best; objects whose surfaces are not flat planes (like a box, for instance), but nicely varied and not elaborately divided into parts.

Pottery.—Yet another very interesting series of exercises can be given in the making of simple pottery shapes. As the children need not be confined entirely to the copying of examples placed before them, this lesson affords an opportunity for originality and invention. The lesson would be suggested, so far, step by step; a lead given, and the children could then finish in their own way.

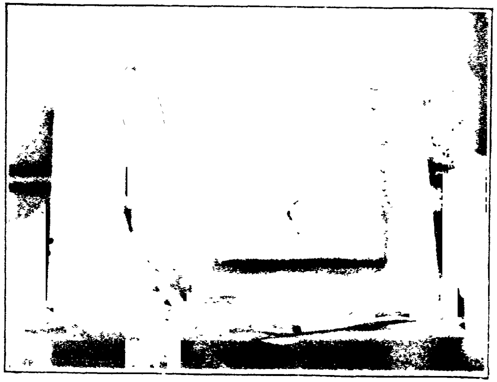
Let them make a ball of clay about as big as a cricket ball. Flatten it to a disc about one inch thick, by gently pressing it on the table or modelling board with the flat palm. Proceed to hollow this out by pressing the thumb down on the centre, and turning with a circular motion, as in Fig. 5. The result of this operation should be a bird's-nest-like shape, and care must be taken not to get the bottom too thin.

Next place the thumbs inside, and with the fingers outside press the clay bit by bit, working from the centre of the base in circles, gradually spreading outwards and up the side wall to the top, until the thickness is everywhere reduced to about one-quarter of an inch. Give special attention to the edge of the base, just where it turns into the side wall, which should not be left too thick. Do not let the top edge crack and break or get too thin. Should any cracking occur, stop and mend it up at once with a little wet clay (Fig. 6).

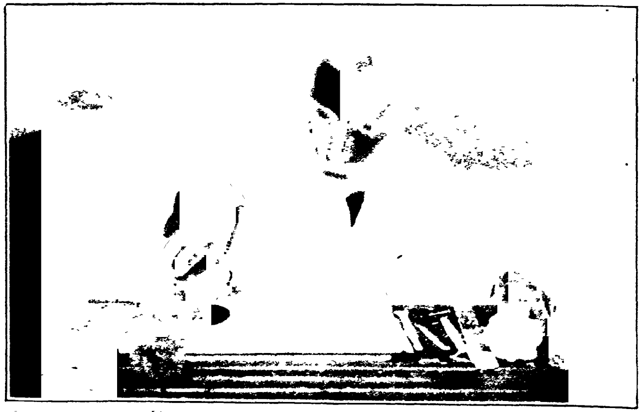
—GROUP OF MODELS



MAKING A SLAB



FIRST STAGE



SECOND STAGE

FIG. 13.—MODELLING A SIMPLE LEAF: THIRD STAGE

FIG. 14.—MODELLING A SIMPLE LEAF: FOURTH STAGE

FIG. 15.—A SIMPLE LEAF: FIFTH STAGE

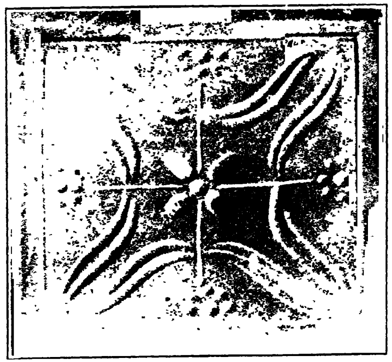


FIG. 16.—THE ORNAMENT, INDENTED

In doing this work, the clay will spread outwards, but if it is desired to keep the vessel narrow and high, it can easily be closed in again. Study the position and action in Fig. 7. With both hands grip a small portion of the wall between the forefingers and thumbs, and press the hands closer together, crushing the clay between them. Repeat this step by step all round, when it will be found that there is a considerable decrease in the diameter of the top, and a corresponding increase in the height. Should this spoil the roundness or smoothness of the shape it can easily be put right again with a little more work. Be very careful to smooth the inside nicely with the wet thumb. If desired, the outside may be decorated after the manner of the roundels previously illustrated. Do not be over ambitious at first. A small dish, like an ash tray, is easy, but quite enough to attempt at the beginning, and quite sufficient to admit of widely varying treatment in its finish.

From this point encourage the scholars to put their own thought into their work. Show how easy it is to turn the margin out or in, to pinch it into a scallop, to change the round shape into a square, or what not. Some, greatly daring, may even add handles, or convert their little dish into a candlestick or other useful article (Fig. 8).

This is an exercise that never fails to excite the keenest interest in all classes, and if it is possible to have any of the articles glazed and fired at a pottery, so that they can be taken home for actual use, the pride of the little workers knows no bounds. Though many children find it difficult to do at first, it is really a very easy lesson.

Only experience will teach one how far to go with each step, when to lay it aside to harden before attempting the next, and not to expect clay to take and retain a fantastic shape that its own weight would break or change.

The Slab.—Referring to the illustration (Fig. 9) it will be noticed that several of the exercises, viz. the top, the turnip, mushrooms, apple, shells, and leaves, are worked upon small flat slabs of clay. Though this is not absolutely necessary in many of the earlier exercises, it is advisable for most, and quite indispensable for some of the more advanced. The thin point of the

top, the tail of the turnip, or the stems of leaves, would be very difficult to make in soft clay if we had not some such support for them; and should you wish to preserve the models, these projecting parts are very easily broken off in handling. Sometimes they will crack away merely in the drying. The air circulating about the exposed surface of a small thin piece will extract the moisture from and make it dry. In drying, clay contracts, and the small piece may break away from the larger. If the work is properly built and supported on a slab it is much stronger in every way.

A very frequent question with teachers is, "When do you introduce the slab?" The answer is, of course, that every teacher must find that out for himself, for each class that he takes. It can and should be dispensed with at the beginning, but it is not a difficult thing to make, and whenever the teacher thinks the work would look better, or gain in any way by its adoption, then is the time to introduce it. When taking the slab for the first time it is well to make a formal exercise of it, and to deduce or suggest a method by which to build it up on true modelling principles.

The slab in a piece of modelling takes the place of the frame round a picture. It provides a background and setting, in keeping with the finished work, and it also makes it easier to handle models when the work is done. For this it should be built very thoroughly. Care must be taken to incorporate the pieces of clay which go to make it. Commence by moistening the surface of the modelling board and place a piece of clay upon it. Form this into the top left-hand corner of the slab, making the thickness about one-half inch, and keep the edges straight, square, and sharp. Flatten the upper surface with several sweeps of the thumb, then add another piece of clay (Fig. 10). Make sure, first, that it is thoroughly joined right through the thickness, smooth the top as before, and go on building until the desired size and shape is laid out. A flat piece of wood or a ruler may be used to trim the edges and scrape the top surface true.

Thorough building and joining of the pieces is essential, if the models are to be kept. Where rolls or pieces of clay are loosely put together and smoothed over on the top surface only, the slab splits and cracks in the drying, and may ruin the work placed upon it. There are, of course, many other and quicker ways of

getting a slab, and later, when it is merely a means to an end, and will possibly be cast back into the bin at the end of the lesson, the quickest method will be preferred.

Leaves from Nature.—Taking the slab as a preparatory part of your exercises will enable you to introduce new features into the work, and several very interesting sets of models for study. Leaves, for instance, provide a whole range of lessons for the various stages.

Choose some simple entire leaf, such as the laurel or elm—these are generally of good shape and proportion, and have their details clearly defined—and begin by building a slab about half an inch thick, and at least one inch longer and broader than the chosen model. On this slab sketch the plan-view of the leaf as it lies on the table or board beside the pupil (Fig. 11). It is needless to draw details here, but the main lines, *i.e.* the margins and midrib, should be truthfully, though roughly, indicated.

Next find the point on the margin which stands highest in relief, and place a piece of clay on the slab to imitate this. Test the effort here by placing a pencil on the table, and measuring the actual distance of the point from the surface of the board (Fig. 12). Apply this to the clay, when it will, in all likelihood, be found that you have under-estimated the size. Put this right, and build half of the leaf solid within the sketched plan. The side of the mass which rises from the margin should be perpendicular to the slab surface. The other side should faithfully (though roughly at this stage) imitate the rise and fall of the leaf surface.

When this is done test the drawing of the upper margin very carefully by walking round the work and viewing it from all sides; or, if that is not practicable, turn the work and model, so that they can be compared and tested from all sides. Especially test by raising them to the eye level, so as to detect errors in its elevation. This testing should be done quite frequently. Learners are inclined to work too long in one position, getting some things right perhaps, but finding too late that all their work is for nought, when tested from another point of view. Those who have already done much drawing are very prone to forget that in clay one must draw from every possible point of view.

When this mass is right, sketch on it the elevation of the

midrib and proceed to build the other half of the leaf between this line and the other margin. Test again as before, and carefully model and smooth the whole of the upper surface (Fig. 13).

Then put in the venation. Generally the veins (being round things, while the leaf surface is thin and flat) are raised either on one side or both. They consist of midrib, stretching from the stem to the leaf point, side veins stretching from the midrib to the margin or near it, and a small network of veins between these, which it is generally found better not to attempt. If the veining on a small leaf like the laurel is to be done, it means work with the tool, but do not use the tool like a drawing instrument, to scratch the lines on the surface of the modelled leaf.

This does not represent any degree of truth in venation, and it would be better to leave the thing unattempted than to employ such an untruthful and inartistic method. It is better to leave a thing unsaid than to tell an untruth. If the vein is raised, then raise it on the clay by depressing the surface at both sides, if it is the bottom of a groove with gently sloping sides, again, draw and model each one truthfully by depressing the clay with the modelling tool, as in the illustration, Fig. 14. This is delicate work, of course, needing care and patience, but if the efforts are to advance in difficulty, something of this kind must be introduced before the complete realisation of natural things can be attained.

Finally, notch the margin with a few quick, neat touches of the modelling tool. Cut away some of the packing clay from the under surface, smooth and tidy up the slab, and the study is complete. If now laid aside to dry it will shrink a little, loosen itself from the board, and turn almost pure white in colour, but otherwise it will remain permanently as the scholar has made it (Fig. 15).

The above method answers for the modelling of almost any leaf or spray, and stands as the type for many lessons. In selecting leaves for modelling, choose specimens which are normal of their kind, and take kinds which do not grow too flat, but twist a little, to give a play of light and shade on their surface. They should not be too much cut up at the margin or wrinkled on the

FIG. [illegible]. SLAB SHAPED AND MODELLED. LOW RELIEF. FIGURES LAID ON IN COILS

FIG. [illegible]. SIMPLE DESIGN. RIGHT HALF SHOWS HOW THE DESIGN IS LAID OUT. LEFT HALF IS FINISHED

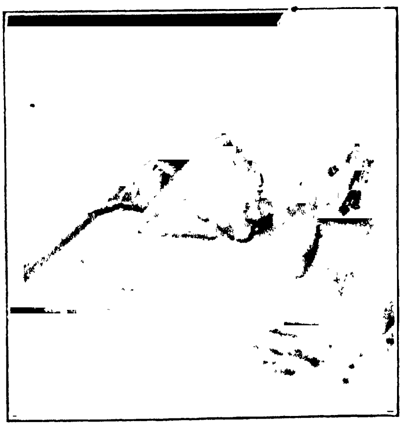


FIG. [illegible]. A FINISHED SHELL

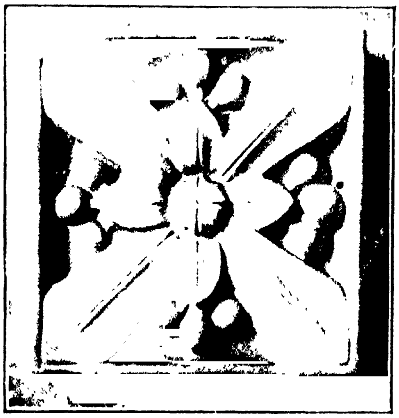


FIG. [illegible]. MODELLED FROM A CAST. A QUARTER OF THIS IS SUFFICIENT FOR AN EXERCISE FOR ONE PUPIL

FIG. 21. MODELLING AND ENLARGING A HALF LEMON

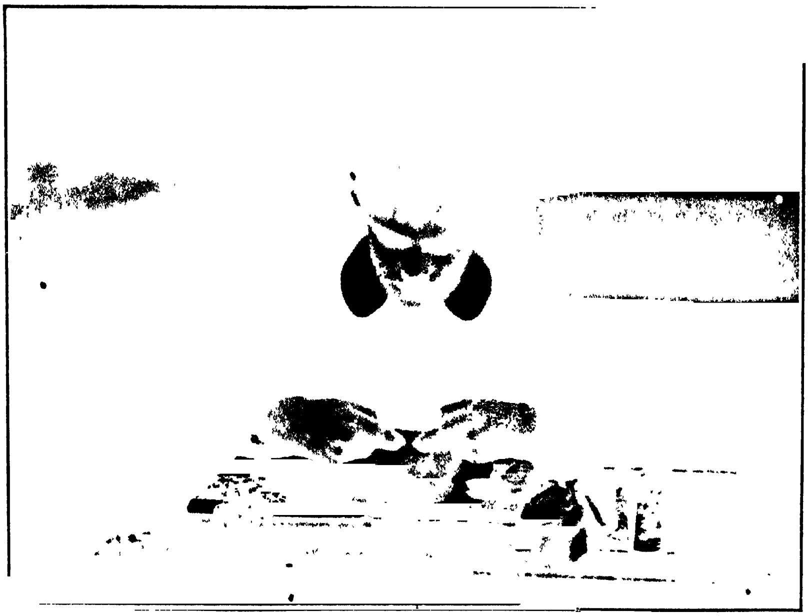


FIG. 22. MODELLING A SPOON

(Method exactly as described for the simple leaf)

surface. The lilac, plantain, apple, coltsfoot, dock, water-lily, ivy, oak, plane-tree, rose, would be more suitable than the dandelion or convolvulus, which are flat, complicated in outline, or of so soft a nature that they would not retain their shape for the space of a lesson.

In this series may be included a few of the open flowers, such as the daffodil, Christmas rose, or dahlia ; flower buds, such as the tulip and rose, etc., and many of the seed vessels of flowers and the fruits of wild trees, like the plane, alder, and catkins. All of these make kindred examples, and would be treated in a similar manner to the simple leaf, though the round bud or seed vessels would be roughly shaped in the hand before being put into position on the slab. With regard to this point, reference might be made to Fig. 3. In this study the shell has been modelled roughly in the hand, care being taken to have the drawing right on all sides so that the model will rest on the slab, with exactly the same poise as the natural shell. A roll of clay is then packed well in below the shell so as to join the two pieces and make them one. A simple modelling tool or blunt pencil is necessary to enable a child to do this. For junior classes these models must be selected with great care, as it is a mistake habitually to give the children more than they can be reasonably expected to accomplish in the time.

Simple Design.—The final set of lessons which may be suggested for this stage has also the slab for its basis. Slabs of varying size and shape may be made and decorated, introducing the subject of design in a simple and easy way. Draw on the clay surface, with the moist fingers for practice, indenting lines and dots in some orderly repetition to form a pattern. Notice the clean depression which the moist finger leaves, with no raggedness at the edges. Now try to do the same thing with the modelling tools, remembering that you do not wish to *cut* the surface, but to make a neat, clean depression. Try square tiles of six inches side, and start by spacing off a border (make lines of varying depth or breadth) and a series of radiating dots from the centre, much in the same way as the roundels were done. This will make a very good beginning to design work. Reverse the method, and raise the ornamental lines and dots, by laying

on thin rolls and balls of clay along the previous indentation or on the flat surface (Figs. 16 and 17).

This will lead on to modelling in *low relief*, by taking some leaf study formerly done from Nature. Make some conventional repeat arrangement of this form inside a geometrical outline; sink the background very slightly, or lay the leaf forms on in thin layers of clay; depress or raise the layers here and there to produce light and shade in the surface, imitating the relief, just as the modelling on a coin, though a flat thing, coveys faithfully the rounded appearance of the features and likeness of the reigning sovereign (Fig. 18).

Reference to the illustrations Figs. 18 and 20, two examples of low relief design, will make more clear what might be done in this way.

Sufficient material has now been given to carry any teacher through the work of the junior classes. Indications have been given as to where to look for a wealth of suitable material for study. If the teacher has had some instruction in the work, and can demonstrate simple processes, similar to those illustrated here, it will only require a little planning and experiment to enable him to formulate a thoroughgoing scheme of lessons, worthy in themselves for their educative value, and such as will develop skill in himself and pupils and be of service in many other ways.

Equipment.—The equipment for this work is simple, cheap, and easily obtained. About 1 cwt. of clay for every thirty pupils will, with care, last a whole session, even though the best efforts are stored and kept. This clay may be kept in the room in a zinc bin or common zinc pail, a good ordinary wooden box with lid, or in a couple of earthenware basins. In each case it should be covered when not in use with a wet flannel cloth. Small boards or slates to model on, one for each scholar, and one or two modelling tools, costing not more than 3*d*. each at the most. Sponges, which can be purchased at any penny bazaar, complete the whole outfit. Beyond this there may be an occasional expenditure for models, but pupils very often solve this difficulty for themselves by bringing their own.

XXXVI. CHIP-CARVING

By E. Hamnett

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Aim.—The aim of this short article is not to plead for the adoption of chip-carving as an ideal handwork subject, but to give a suggestion of what might be done, in a simple recreative and decorative craft, with restricted tools, to increase the field of activity, so that the ordinary manual education of our children may be strengthened step by step, at every stage, by the simplest elements of artistic handwork.

The old craftsmen delighted in finding new difficulties of working every material which could be woven, chased, or tooled; they dignified handwork and added beauty to their surroundings.

All work should have in it the elements of beauty in construction, in proportion, and in decoration. This applies just as truly to the planning of a palace as to the pattern of a finger-plate The appreciation of simple beauty needs to be cultivated, but until a definite design to fulfil certain conditions is required, appreciation is not fully aroused.

In chip-carving the combination of designing and doing has a decided cultural value. It gives more creative power, more responsibility, more forethought, and more joy in doing.

Children love to tinker in an amateurish way at home, as a means of recreation, and under the friendly guidance and help of the teacher systematic work in this craft may be readily attempted and the habit of industry inculcated

Traditional Schoolboy Chip-Carving.—Chip-carving was practically the earliest form of handwork practised in the schools. It was treated with contempt and disgust by the teachers, and

dire penalties inflicted on any one caught pursuing the craft within the school. The busy and interested workers knew the risks they ran, yet practised assiduously their craft in secret. The scene of operations was usually the desk top, or the wooden stanchions, the beloved and useful pocket-knife the only tool required, and the design took the form of the initials of the young craftsman.

Cut and carved desks and stanchions were the toll paid for restricting the normal tendency of childish activity.

It is fully recognised now, that the natural tendency to do is normal, and that, properly harnessed, the constructive or destructive activity of the child is its greatest asset. Any craft, if it be carefully analysed and the correct method of approach, and its limits, be carefully considered from a psychological standpoint, has some educational value, and good will accrue from its adoption in direct ratio to its appeal to the child.

History of Chip-Carving.—"The first carving in wood was the parent of all sculpture, and he who first carved it was the first sculptor." (Alfred Maskell, *Wood Sculpture.*)

Primitive man, with his natural love for ornament, carved the handle of his war club with lines, curves, and crude patterns, and at the same time increased the value of the grip.

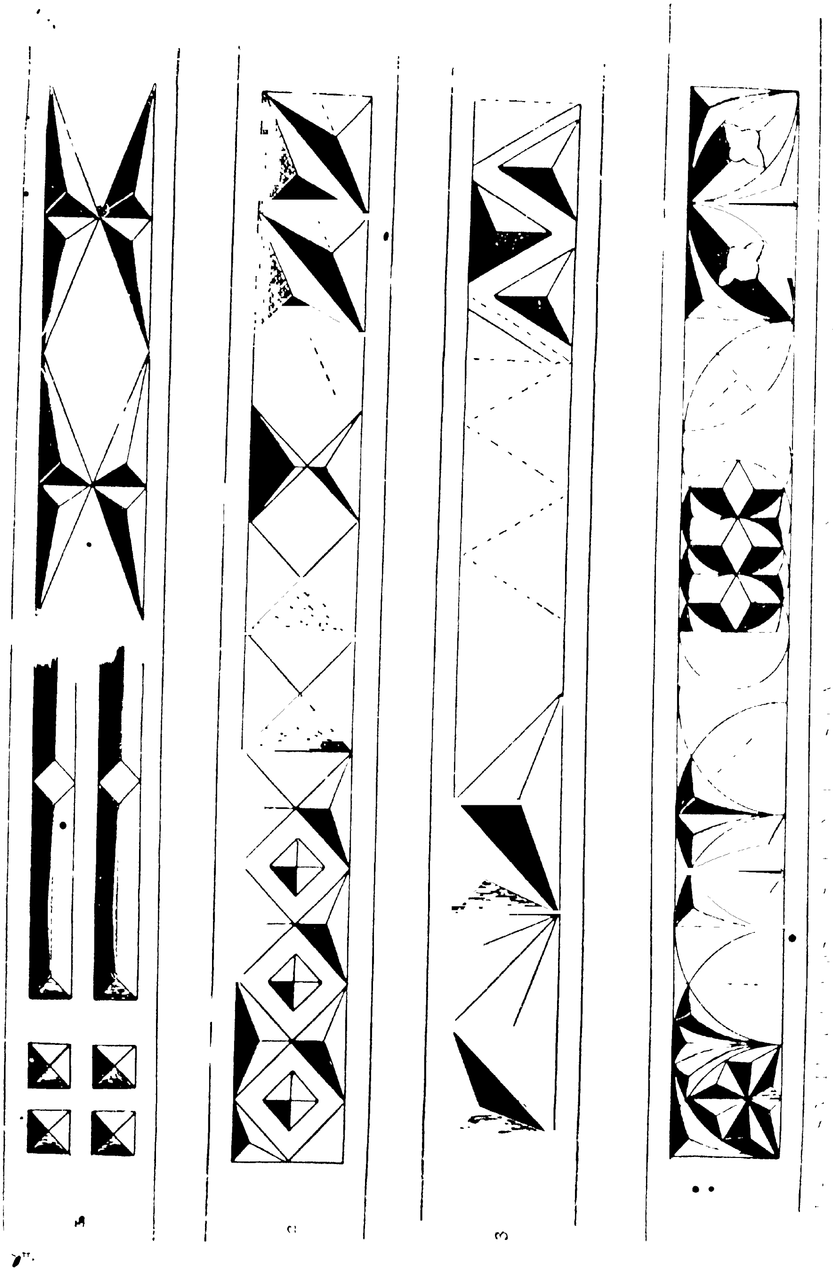
The South Sea Islanders and the Ijos of the Niger adorn their paddles and canoes, the Kaffirs their spoon handles, and the North American Indians their wooden pipe stems or fish-hooks, with notches and deeply incised spiral ornaments, showing their appreciation of the effective contrast with decorated surfaces.

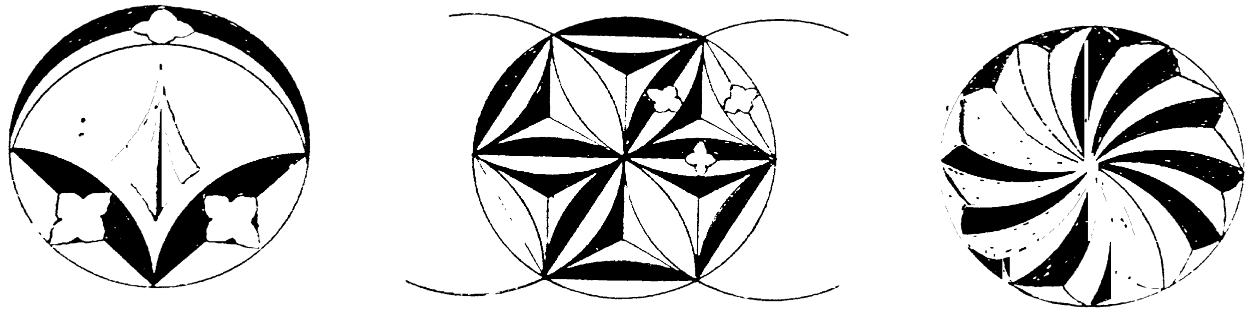
At the present time, the craft is practised in Norway, Sweden, Denmark, Iceland, Friesland, and some parts of Germany, and some very fine examples of painstaking and accurate work may be seen on marriage chests, tables, chairs, stools, etc.

The term chip-carving is applied to patterns mainly geometric, in which the surface of the wood, and the pattern chipped out, play an equally important part. The principal and only tool in many cases is the knife.

The early carvers of the Jacobean period were really chip-carvers, a characteristic design of the period being the well-known strap pattern, incised on panels and wainscots.

The new expression of this old craft is decidedly marked, and





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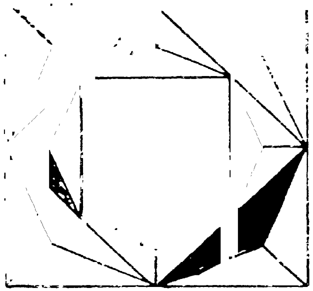

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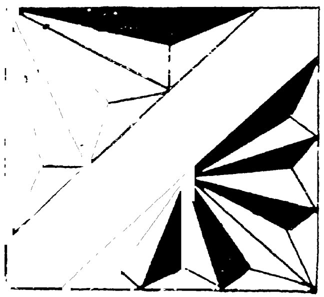

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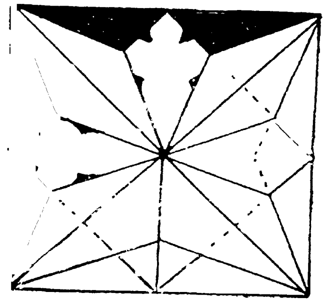


SQUARE FILLING

in direct contrast to the old. In the old style, every part of the article was covered with a mass of rich detail, and indifferent work was not obvious unless closely scrutinised. The modern tendency is for simplicity and grace. The introduction of plain flat surfaces affords the necessary contrast for appreciation of good workmanship. This style demands a higher standard of execution than the old style, as every cut stands revealed and offers no cloak for indifferent work.

Again, the length of time taken in working the new and old styles is worth considering. The new style demands more care and time per unit, but the smaller amount of work involved more than balances this.

Its Educational Possibilities.—The degree to which chip-carving satisfies educational requirements depends upon, (*a*) the kind of work considered, (*b*) the manner in which it is taught, and (*c*) the extent to which it is carried.

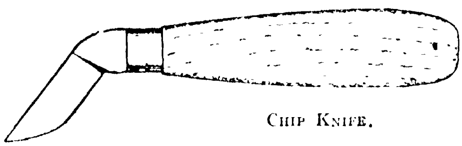
To satisfy condition (*a*) fully, it should be preceded by a knowledge of construction, and therefore combined with the work of the woodwork class; for condition (*b*) it should be progressive in difficulty, and give scope to the child to discover the varying degree of the fibrous nature of woods, it should be subservient to construction and utility, and an aid to geometrical drawing and design; and finally, condition (*c*) is satisfied as long as it makes progressive demands on the intelligence of the learner, does not degenerate into a mechanical operation, is not fatiguing and trying to the eyes, and teaches persistency, carefulness, industry, neatness, and truthfulness.

Method of Teaching.—To commence with, the design should be simple, consisting of straight lines. The boy should be provided with two or three simple examples, and with the aid of pencil and squared paper, he should deduce the elements of the design. He should be asked to modify the design, or rearrange a new combination, to suit the work to be ornamented.

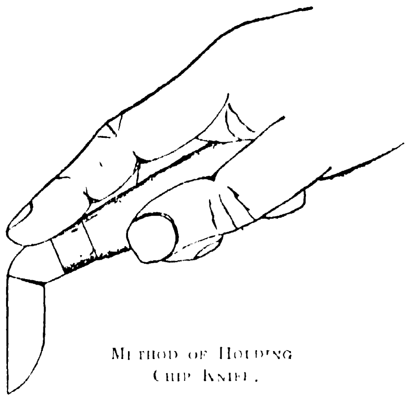
"The making of new forms and combinations, the giving of definite expression to ideas and mental images, the rendering of the inner outer, is the great Froebelian doctrine of creativeness." (*Report on Technical Education*, Toronto, 1907.)

The endless combinations of simple geometrical units would

form a good class problem in design (see Plates). Good clean cuts can only be made with the grain; therefore, the true and broad significance of "with the grain" and "across the grain" should be amplified by black-board sketches.



Chip Knife.



Method of Holding Chip Knife.

In cutting, it is obvious that the shape of the knife will determine the position in which it is held. The boy will readily see the goal aimed at, encouragement will be all the help necessary, and any weakness, hesitancy, and want of sympathy between head and hand soon make themselves felt upon the work produced.

Good sharp knives are essential, and the children should be taught to sharpen them.

Designs. — The designs are based on the square, triangle, circle, etc., and exact setting out and neatness are necessary conditions of success (see Plates).

A good sharp pencil and reliable compasses are required to mark out the designs, and the form of the article to be decorated should be taken into account, and used as a base or motif. Plain flat surfaces, judiciously interspersed, effect a pleasing contrast, emphasise the motif of decoration more than an "all-over" pattern, and relieve the eyes during work.

The introduction of freehand curves for corner filling, noticeable in the new designs, is to be commended.

The numerous objects of home life to be found in the woodwork room lend themselves for decoration, such as finger plates, teapot stands, letter, pipe, book, and key racks, etc.

General Hints.—The objects to be decorated should be constructed of soft, light, and close-grained wood; *i.e.* lime, satin-walnut, chestnut, kaurie pine, alder, canary wood, poplar, sycamore, and yellow pine.

Curved designs, with pockets introducing concave and convex cuts, are obviously more difficult to work than straight, owing to the varying direction of the grain, and to prevent disappointment they should not be attempted too early.

In working, the cuts should be sweet and clean, all one depth, and not exceeding 45°. The natural tendency in cutting is to allow the force to act in a vertical direction, and so make deep cuts This must be guarded against to ensure neatness and correct working of the design. If properly cut, the chip can be readily blown or brushed out; should it not do so, on no account use the knife as a lever and the surface of the wood as a fulcrum to remove it; repeat the cut. It is safer and easier to cut the long sides of a pocket first, as the small triangle at the base acts as a stop and prevents a slip

Do not use glass-paper after carving; it takes off the sharpness of the work.

To improve the appearance of the objects when carved, they should be stained with any of the well-known water stains, and when thoroughly dry, brushed or rubbed with wax polish, a mixture of beeswax and turpentine, until a faint gloss appears. Satin-walnut does not require staining, it should be given a coat of raw linseed oil, and when dry, polished with wax polish or given two coats of French polish.

Hints on Working.—Fig. 1 is a simple element, or pocket, typical of the recurring ones in chip-carving, and the method of cutting this pocket is applicable to the majority.

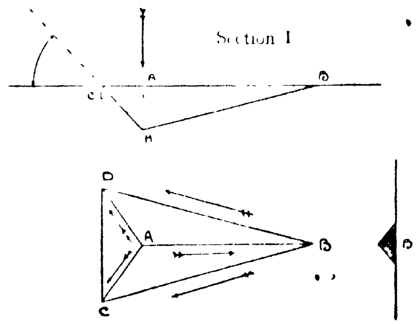


FIG. 1.

To commence, the knife should be grasped firmly as shown in the illustration on

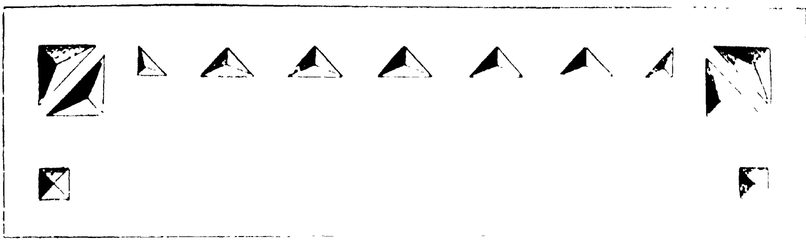
page 114. The point should be inserted at A and pressed down in a vertical direction to the required depth, and then drawn along line A B until the point reaches the surface of the wood at B. The section shows the true depth and the true length travelled by the point of the knife. This operation is repeated along the lines A C and A D. This is called "setting down." The aim of the next cut is to remove one of the triangular pieces A B D, A B C, or A D C, in one piece. It requires less force to cut gradually down to a depth, so take a cut from B to C first. The triangular piece A D C will act as a stop and ensure cleaner work. In making this cut the knife must be held at the required angle, and pressed home until it meets the base of the vertical cut throughout its length. If held at the proper angle, the two cuts will meet and the chip will be free. Should the sloping cut be made too deep, the operation of "setting down" will have to be repeated and the pocket deepened. The triangular piece A B D is removed in the same manner, commencing the cut at B The last cut is to remove the piece A D C at the angle shown in Section I.

The figures shown in the Plates are suggestive designs for the decoration of common problems in woodwork classes.

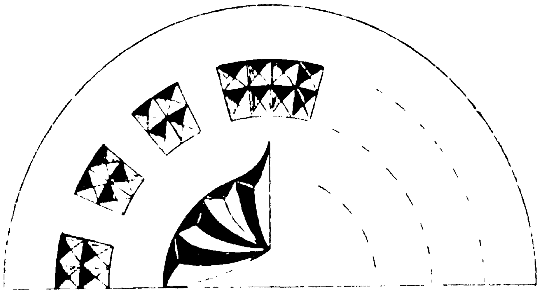
In the design given for The Pencil Sharpener, the one-time common notching of picture frames is applied. The cutting or carving is simple, and forms a good beginning for exercise on the correct handling of the knife and a knowledge of the grain of wood. In working this exercise the long cuts should be taken first. A cut is made at A to prevent the knife following the grain, and cuts made right and left from B and C towards A. If properly cut, the resulting surface will appear as if one sweeping cut had been made. The same method is adopted for the notches.

The succeeding problems are based on the Fig. 1 element with slight variations, and if the instructions for working Fig. 1 are carefully followed, there should be no difficulty in working them.

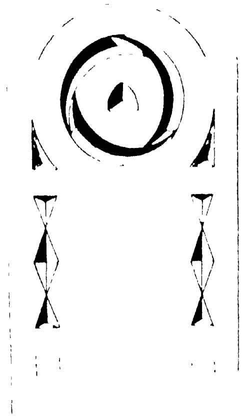
Tools.—Much good work may be done with an ordinary pocket-knife, or Sloyd knife, although there are special knives on the market; and to carry out some of the more intricate patterns



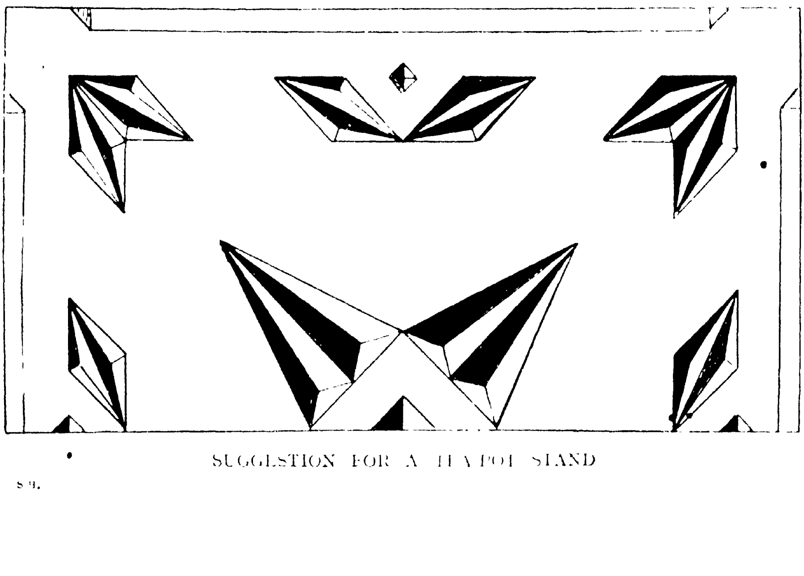
SUGGESTION FOR A KEY RACK



SUGGESTION FOR A LETTER RACK

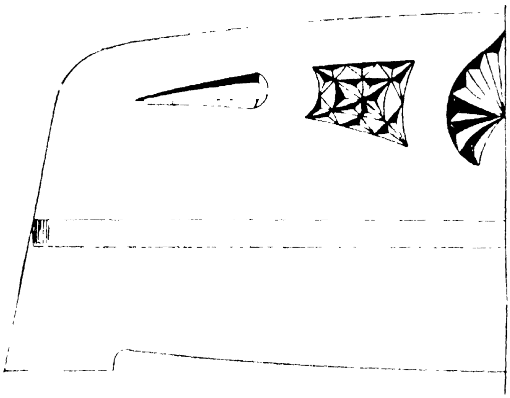


SUGGESTION FOR A FINGER PLATE

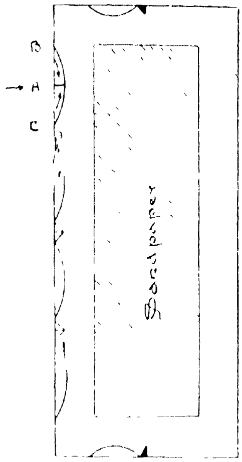


SUGGESTION FOR A TEAPOT STAND

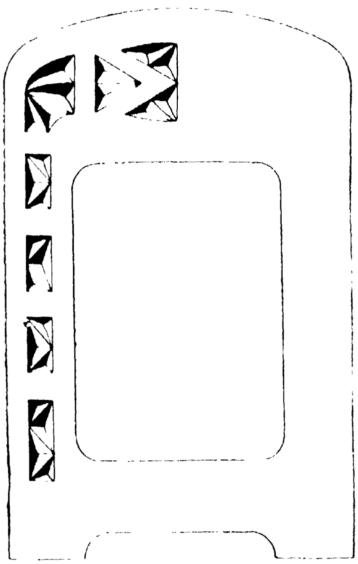
S 9.



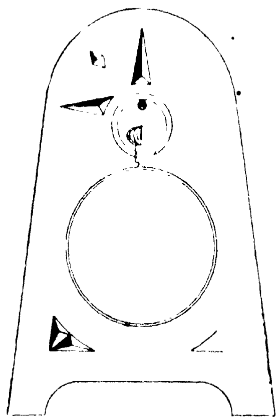
SUGGESTION FOR A PIPE RACK



SUGGESTION FOR A PENCIL SHARPENER



SUGGESTION FOR A PHOTOGRAPH FRAME



SUGGESTION FOR A WATCH-STAND

it will be found advantageous to have a small skew chisel and an extra flat ¼-in. gouge.

Many teachers prefer the use of the "veiner" and "spade tools," but these do not afford the same opportunity for training the muscles as the knife. The tendency of modern designs is to give full play to the veiner, and delicacy of touch and skill are necessary for their proper execution.

A hand screw, G cramp, bench holdfast, or vice should be used for fixing the work firmly to the bench or table.

For sharpening the knives, a good oilstone and strop are necessary, and for gouges and veiners, finger slips.

The designs are set out in pencil, with the aid of rule, compasses, dividers, and rubber.

BOOKS OF REFERENCE

W. JACKSON SMITH: *Chip-Carving* (Upcott Gill) ELEANOR ROWE *Chip-Carving* (B. T. Batsford). *Needlecraft*, No. 20. *Woodworker*, Vol. XI *The Arts of Woodcarving and Pyrography* (The Butterick Publishing Co.). MISS J. B. BURY (Translator): *Directions for Chip-Carving* (O. Newmann & Co.).

XXXVII. LIGHT METALWORK

By J. Scott Knight

Teacher of Handicraft at the Hornsey County School; formerly Editor of "Manual Training"

Aim and Scope.—The problems here suggested are suited for use in the last year of the Elementary School or as an introduction to metalwork in Central, Continuation, or Secondary Schools. In each of these cases the desirable end seems to be interpretation and suggestion, rather than the acquirement of skill along one narrow line. Hence processes, such as flat filing, which make a heavy demand on adult skill, have been excluded in favour of those which, while calling for much close attention, deftness, and resource, are yet easily within the power of the average boy or girl.

One side issue of such a course (it may indeed be *the* issue) is that no pupil can, after tackling these or similar problems, fail to regard very differently that considerable portion of his material environment which consists of metal, and so one of the fetters of constructional ignorance, fetters which have doubtless held many a potential Watt or Nasmyth, is struck off.

Tools and Man.—Two simple examples are provided where the steel used must be hardened and tempered This property of tool steel, whose wonder is hidden behind the commonness of its application, is, after all, the prime factor in man's power over materials, and it is well that every boy should have first-hand experience of working steel while soft and of using it for his own purposes after he has hardened it. The expansion gauge has been included, partly as an example of the fineness to which metal can be worked, partly in sharp relief to most of the other work, and partly as showing that what is sometimes inappreciable by sight is readily perceptible by touch.

The Need of Skill.—While the intention of the teacher when

using metalwork may vary according to his convictions or his prejudices, the intention of the boy when doing metalwork does not vary. He means to make as many things as he possibly can, putting, if rightly handled, the best of his thought and skill into the making, and reaping incidentally a growing sense of power and of pride in the efficiency of his doing. With this in mind it should be remembered that some important processes in metalwork are difficult to master if taken in one's stride, as it were. They need separate consideration if their essentials are to be rapidly and completely grasped, and if it is to be made clear, as it should be, that success is not a matter of chance but a case of providing exactly that technical skill and that set of conditions which will bring about a desired result.

Soldering.—Soldering is an excellent example of this. One often hears, even among teacher students, "No, it's a doubtful sort of business, and I never have any luck with it," in answer to the suggestion that soldering might be employed in a given problem. The conditions making for successful soldering are few. They are (1) surfaces mechanically clean and protected by a coating of flux, (2) a joint sufficiently close for the fluid solder to run through by capillarity, (3) a sufficient supply of heat to bring the metal up to the melting-point of solder, (4) enough solder to make the joint.

If the object is made of tinned plate suitable surfaces are already provided. Brass, copper, zinc, and iron need mechanical cleaning by file, scraper, or emery cloth. A solution of zinc chloride (usually made by dropping zinc-cuttings into hydrochloric acid) with a little ammonium chloride is a satisfactory flux. The quantity required for use should be kept in a shallow pot (such as a fish paste jar) sunk in a block of wood about 7 in. by 7 in. by 1½ in., planed off into a very squat pyramid. It will then be secure against upsetting. The flux may be applied by a small brush; or a piece of cane beaten out at one end is good, as is a swab in a twist of wire.

The heat is most commonly supplied by a copper bit. Tinsmiths test its temperature by holding it near the face. Boys should be taught to use the inner surface of the wrist—there is less risk of accidental injury. All the surfaces of the tip of the

"iron" should be kept clean and flat. "Pits" in the surfaces (caused by prolonged and over-heating) prevent the solder from flowing freely. A tray of powdered sal-ammoniac is convenient when "tinning" the soldering bit after filing up. The facet which it is desired to tin is laid on the sal-ammoniac and then on the solder.

In actually teaching the process of soldering, it will be found that by first getting the problem stated as that of causing a fluid to flow between two surfaces, and then examining the behaviour of mercury on a greasy surface and drops of water on a hot plate, there is no difficulty in getting the conditions for success defined. It then remains to demonstrate that dropping blobs of molten solder on cold metal is useless; the speed and facility with which seams can be soldered; the failure of solder when used where a straight edge meets a flat surface without a flange or angle piece to increase the area of contact, and conversely its success when used in a mechanically sound manner. In passing it is interesting to note the answers to a question concerning the behaviour of the solder on the bottom of a kettle.

Three small hints may be of use. There should be an excess of acid in the flux when soldering zinc. The commercial soldering-iron is too long in the stem for boys to hold it steady. When girls, evening students or teachers are taught, to whom stained hands are a trouble, and not, as with boys, a source of pride, a few drops of sperm oil before washing will remove the stains the fluid causes.

Filing.—This also is a process which needs and will well repay a little consideration, for it is so easily possible for pupils to produce a maximum of noise and remove a minimum of material, especially in the case of sheet metal. It should be insisted throughout that effective filing is comparatively quiet, and the gain, both in speed and finish, of holding the work low in the vice, of using a middle cut or fine file, of filing obliquely to the edge, can be easily and quickly demonstrated.

The class should think out the methods of producing concave and convex curves, and the utility of the "safe edge" of rectangular sectioned files. They should see the effect of free wrist movement and the economy of the long deliberate

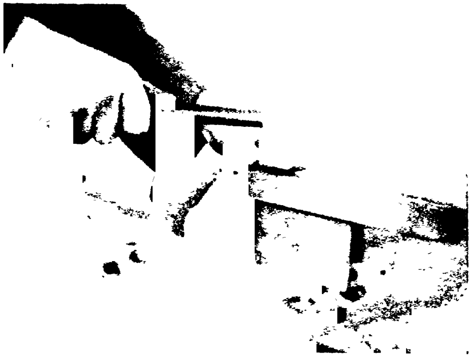


FIG. 2[illegible].—BENDING WITH FOLDING BARS

FIG. [illegible]7.—RIVETING LANTERN BODY, RIVET SET IN VISE

FIG. [illegible].—DRAW FILING

FIG. [illegible].—[illegible]TING OPENING IN EXTENSION GAUGE

FIG. RAISING PART OF STUDY LAMP

FIG. MAKING TUBE BY DRAWING

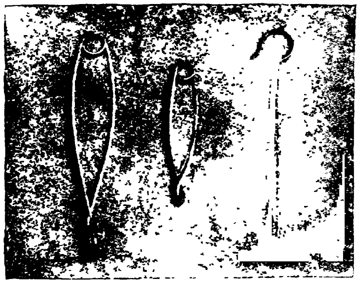


FIG. EGG TONGS, FUSE TUBE TONGS, AND PIPE LIFT

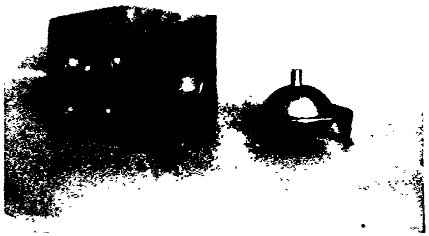


FIG. 28. DOMING STAKE AND SPRAY LAMP

FIG. MAKING TUBE IN VICE

stroke, and hear the waste of energy by pressure on the return stroke.

Some General Hints.—Other processes should be dealt with in like manner as they arise. Skill in handling material may be reached without any such consideration of the processes. Over-detailed consideration may indeed retard skill, but in educational practice one may incline to a belief that the development of an imaginative perception of what is happening 'twixt metal and tool is a pure gain, and that the habit of recognition and arrangement of the factors in whatever problem is in hand, is invaluable even if its value is limited to the particular activity which fostered it.

The particular form in which any particular problem is presented in this article is of little moment, especially as regards outline. Every scope should be given to individual taste and feeling, remembering, however, that a fair proportion of "fixed" designs is necessary or the work deteriorates.

Problems should ordinarily be presented in some such manner as is described under the heading of the glass holder. The somewhat trite ornamentations are not suggested with a view to their adoption, but to show how few are the essentials and how many the possibilities. This sense of freedom from external and arbitrary control in decorative design should never submerge the conscientious serving of the main purpose of the problem. One finds only too frequently a positive dread of plain surfaces and straight edges. A word of reassurement on this point is timely; and an example should be shown (such examples soon accumulate), and discussed, in which the straining after ornament has spoilt a thing of utility.

It is not intended that anything written here should convey the impression that the encouragement of expressional work is likely to set teacher and taught adrift on an uncharted sea. Expressional work may be the easiest of all excuses for the results of the irresponsible faddist; it is the hardest of trials for the teacher who expects adult thoroughness from boys and girls; it is most useful when employed with restraint as an occasional and alternative method.

A Typical Lesson: *Glass Holder.*—This problem is treated at

some length, as it is one of a type which, after filling a few simple essentials, are open to an infinite number of variations. The object is intended to introduce riveting, and this should be stated at once. The essentials can then be discussed—what kind of material is necessary, whether zinc, brass, copper, iron, or tinned plate will do best; whether it should be made to fit an individual glass well, or so as to take any odd tumbler; which way up the glass should go; the best way to provide for fixing on a plaster wall or against a wood surface; how water drips can be prevented from reaching the wall, etc.

As a result of this discussion the blank model can be sketched. If two good forms are suggested both may be drawn. Then comes the question of ornament, and here again all reasonable suggestions may be sketched on the blackboard before the class commences drawing. Then with clear ideas as to construction and some materials to select from and improve upon, the class leaves the teacher free to do individual work and discussion while the drawing proceeds.

In the practical work the new process is that of riveting. If a couple of rivets, two pieces of sheet metal, and a hammer are served out to each pupil, and the problem is taken step by step, it is easy to re-discover the whole process. The suggestions that a harder material will penetrate a softer, that iron rivets are harder than zinc sheet, that a sharp blow will be needed, that a piece of steel with a hole in would bring the two pieces of sheet metal close together, and that a forming tool will be necessary to finish off the rivet, will all come with very little help. After some experiments the process can be demonstrated, showing the effect of half-hearted blows, of attempting to punch on the fibres of wood instead of the end grain, of holding the rivet-set askew. Then all is plain sailing.

These methods have their limitations. For example, it is almost unknown for a student to suggest this way of riveting without preparatory questioning, and very few find out the use of the hole in the rivet-set. It is possible to waste a vast amount of good teaching to secure a very little bad learning, and if this is found it is high time for a change of method. With a normally keen class close interest and good work are easily obtained, but

it cannot be reiterated too frequently that materials, methods, processes, etc., have value only if they occasion due response in the boy.

The Models.—Some illustrations are given of well-known physical effects; and the facts that all are well known, and that they take the form of toys, do not lessen either their interest or their importance. There are many more of these simple toys, and their appeal to boys of all ages is so direct that one is tempted to exclude all problems that do not work or perform in some way. It may finally be said that these problems are not presented as an arbitrary "course." He would be a smart boy who would draw and make them all in the narrow time limit usually available, and a very dull boy who would want to do so.

Egg Tongs (Fig. 13).—Some simple piece of wirework such as this forms a good approach to light metalwork. It calls for the use of hammer and mallet in progressive operations, wherein ill-directed blows are easily corrected, and provides the simplest case of soldering. Tinned steel wire is the material chosen, $\frac{1}{8}$ in. in diameter, and about 30 in. is taken and straightened with the mallet on the end of a wood block.

It may here be remarked that it is false economy to allow too short a piece of wire. A piece of $\frac{3}{8}$-in. iron is placed in the vice, and the central bend formed round it, keeping as much tension on the wire as possible, and using the hide mallet if necessary. The angles at the commencement of the rings are then bent, taking care to point one away from the other, and by fitting a pair of sheet metal "clams" to the vice jaws before gripping, to avoid marking the wire. The rings are then bent round a hammer head, using two pairs of pliers.

The value of an inch or two over the net length of wire will be found here, for the forming of a good curve is made much easier, and the waste pieces can be carefully cut off so as to leave a close joint. The two waste pieces can be used for a preliminary trial at soldering. As the metal is already tinned the soldering is easy, the only special point being that to get a good mass of solder the soldering iron should not be very hot.

Alternatives to the egg tongs are the test tube tongs, a pinch clip for rubber tube, and tongs for holding golf balls

during painting, while an even simpler piece of wirework is a bill file.

Another purpose to which wirework can be put is that of making skeleton geometrical "solids." The smaller of these are best made of copper wire, about 22-gauge, because of the facility with which it can, after cleaning, be straightened perfectly by simple stretching. All angles should be formed by filing the wire partly through, thus getting a sharply localised bend.

This applies also to the larger models for teaching purposes. In these latter, which should be made of $\frac{1}{8}$-in. wire, any wire joining the middle of another should have about $\frac{3}{8}$ in. allowed at the end. This is filed away to less than half its diameter and coiled round the wire it meets Soldering then makes a sound and workmanlike job, capable of standing even school usage for a considerable time.

In all soldering work the necessity for cleanliness cannot be too fully realised. Fingering the parts of the metal to be united should be avoided, and the soldering flux must reach every part of surfaces which the solder is intended to adhere to. When the soldering is finished the joint should be tested by straining or dropping, and if sound should then be washed free from the flux. A rough and ready test for removal is to touch the joint with the tip of the tongue.

Steel Scriber (Fig. 1).- This is made of $\frac{1}{8}$-in. cast steel wire, and its making should be preceded by some experiments which

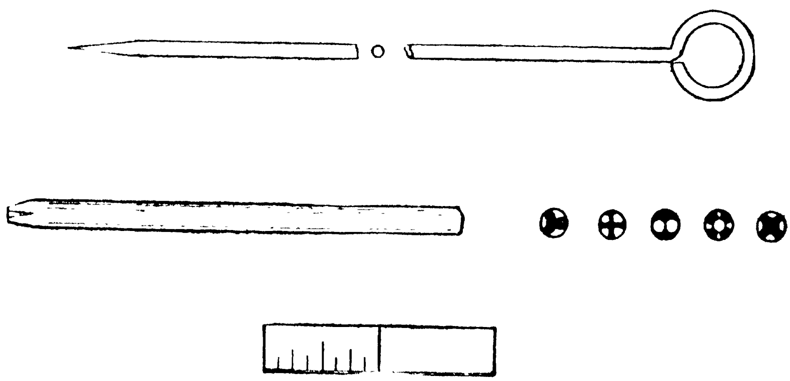


FIG. 1.

will illustrate the properties of tool steel. For this purpose broken hacksaw blades are very convenient. An ordinary bunsen flame rapidly heats these thin blades, and the effect of slow cooling after heating to redness, rapid cooling in water from red heat, overheating, and of tempering after hardening, may all be demonstrated, or, better still, tested, by pairs of boys, with a minimum expenditure of time.

The end of the scriber lends itself to some little variety in treatment. It may be bent into a ring while hot, using pliers or forming it round the beak of the anvil. In the latter case the portion required for the ring should first be bent at right angles with the stem of the scriber. Or, again, the ring portion may be flattened before bending, or left long enough to be twisted with the stem.

The point is filed to shape, the scriber being held by the left hand either in a groove in a piece of wood or against the jaws of the vice, these being opened a little less than the diameter of the wire. These methods of holding are chosen, so that the wire can be revolved while the filing goes on. After hardening, the scriber should be cleaned up with emery, the point finished by grinding, and then tempered.

The point should not be touched by the flame either in hardening or tempering. The time for cooling is at the first change of colour, and the reason for cleaning up first is that if the wire is heated about an inch from the point the range of colours left serves as a permanent reminder of the lesson on tempering.

Hexagonal Tray (Fig. 2).—The material for this depends upon the boy. Copper or zinc, 22-gauge, makes an attractive tray, but requires more care in soldering than does tinned plate. If given a free hand boys tend to choose curves for the edge, which do not improve the appearance to anything like the extent to which they increase the labour and risk of failure.

In cleaning up the metal for this or any other copper, brass, or zinc problem, the need of a surface on which lines drawn in any direction are easily seen should be remembered, and after the main cleaning has been done in two directions at right angles to one another, the surface should be gone over again, rubbing in tiny circles. As a centre mark would disfigure the tray, a scrap

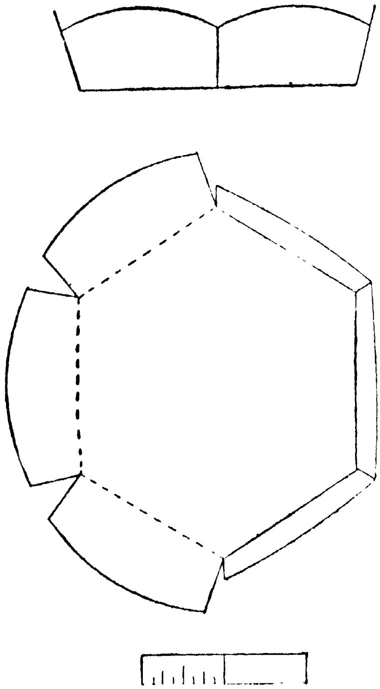


FIG. 2.

of gummed paper should be stuck on to take the point of the dividers. The straight lines should be made with the scriber. In cutting out, the point needing attention is getting the meeting edges of the sides exactly equal.

If the outline chosen is curved it will be found easier to produce good curves if most of the waste metal is cut away first, leaving less than $\frac{1}{8}$ in. outside the line. Cutting with snips distorts the metal a little, and so it should be reflattened before bending up the sides. The sides are bent up with the mallet over the edge of a block, which obviously must be narrow enough to avoid straightening the adjoining edges. The square end of the beak iron may serve for this; in fact, when deciding on sizes, it is important to keep in mind such points as these.

In metalwork it is necessary to go a little farther than the tailor who tradition says cuts according to his cloth, for small differences in size sometimes mean the procuring or improvising of other tools, or the adopting of a tedious and perhaps unsatisfactory method of working. In the actual bending, alternate sides are bent first, and each should be slightly over-bent. Then the remaining sides are turned up, and finally all are tapped and coaxed until they meet closely. The method of soldering is to lute the joint, and then just touch a clean hot soldering iron, lightly charged with solder, with the meeting edges of the sides. If the joint is close, a white line of solder shows inside immediately.

On no account should the soldering iron come in contact with the surface of the sides, nor should any attempt be made to soder

inside. The six joints can be soldered in under a minute, if they are all close and neat, and it is no use trying this or any other method if they are not. After soldering the curves are examined, and any of the corners needing adjustment are filed, the side of the tray resting flat on the edge of the bench, the file travelling along the edge with a slight downward movement. All sharp edges are rounded with emery cloth, and the tray is polished with pumice powder.

Scissors Holder (Fig. 3).—The purpose of this is to introduce another method of soldering. Either brass or copper of 22-gauge may be used. Copper looks better, brass is easier to solder. A rectangle of metal large enough to take both the shield and the strip should be cut, and the flattening and cleaning and marking out should be done before cutting off the strip.

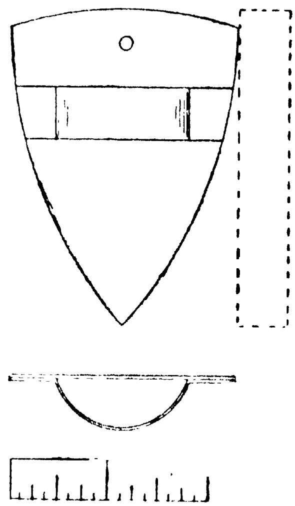


FIG. 3.

The outline is cut as near as possible with the snips, and finished by filing. In bending the strip the angular bends should be made first, using the mallet. Only the fingers are needed for the curve. After the hole has been punched the shield should be reflattened, and if necessary cleaned again. The flat ends of the strip are now coated thinly with solder, and then the bending of the ends adjusted so that they will lie perfectly flat on the shield.

For joining the two, the strip is laid in its position on the back, both being coated with flux, and they are then heated with a bunsen flame. If care has been taken with the fitting and with the "tinning" with solder, they will join without pressure; but if necessary each end may be squeezed with pliers when the solder melts. An alternative method of joining is to heat the end of a thick pair of old pliers (note, *not* cutting pliers). These both supply the heat and clamp the joint. This method has a special application to cases of brazing thin pieces of tool steel (*e.g.* band-

saws), when other methods of heating are likely to damage the steel. Finally, the ends of the strip should be filed to the outline of the back and all edges slightly rounded with emery cloth.

Mark Stamp (Fig. 1).—This little problem, suggested by an American teacher, Mr. A. F. Rose, helps to overcome one of the minor difficulties of teaching metalwork, that of marking individual work clearly. Gummed labels tend to drop off, scratched and pencilled marks are difficult to see, while the stamp mark is unmistakable and indelible. Incidentally, we get a case where accuracy of filing is essential, in getting the end flat and square, and where carelessness in tempering will spoil the whole of the previous work. Boys with initials of simple form usually choose to make them, and, unless reminded, commonly forget the need for reversal.

Geometrical forms also are easily cut. Circular hollows may be drilled, taking care to soften the metal ($\frac{1}{4}$-in. round tool steel) by heating and slow cooling, or an $\frac{1}{8}$-in. steel ball may be put in a centre punch mark on any convenient block of metal, and the stamp hammered down on it while hot. Progress while making may be tested on paper. The hardening and tempering is carried out as in the case of the scriber, but the colour should be yellow just tinged with purple.

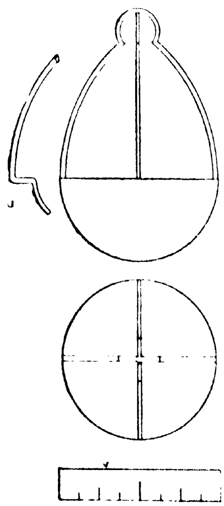


FIG. 4.

Gravity Toy (Fig. 4).—This toy has value in more than one direction. It is a simple case of lead casting giving opportunity for discovering that shrinkage takes place as solidification and cooling proceed, and needing a little ingenuity to overcome the tendency of the wires to float. The mechanics of its behaviour is interesting and important, and being a one-lesson problem, it is a favourite when the two gift-making lessons arrive which precede Christmas, as it makes a capital paper weight.

The bending of the wires needs no remark. If a doming stake (a block of metal with hemispherical hollows) is handy, the wires are placed in one of the larger hollows and the

molten lead poured round them. If no doming stake is at hand, a hollow may be gouged in a piece of wood, or a large glass marble may be impressed in a plaster mould. A wood or celluloid head, or a celluloid ball with a grotesque face painted on, with just enough drapery to hide the construction, finish the problem. A specially droll effect is produced by mounting the head on a swinging wire with a tiny lead bob-weight inside.

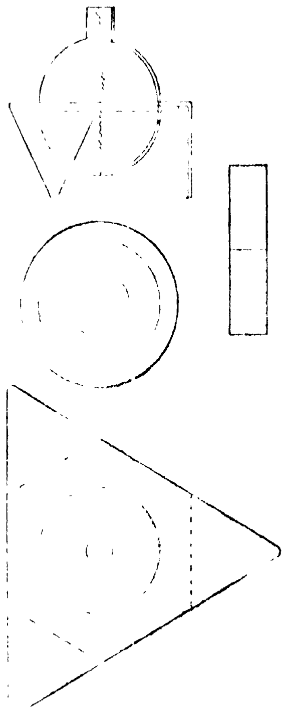


FIG. 5

Spirit Lamp (Fig. 5).—Copper 22-gauge is the most suitable material for this, as being the most ductile material available. The metal should be flattened, cleaned, and then annealed by heating to redness and quenching in water. Attention should be drawn to the contrast in treatment of copper and tool steel.

The circles showing the limit of the raising are marked in pencil, and then one piece is placed over the chosen hollow in the doming stake or a hollow gouged in the end grain of a hardwood block. A few tentative blows with the ball pane of a hammer show if the position is correct, and then the hemisphere may be beaten up. Once the edge is sufficiently defined to make movement safe, the copper should be kept revolving with the left hand while the hammer beats in successive rings from near the edge to the centre. The flat part tends to cockle, and should be corrected frequently.

The under hemisphere should have not less than a ⅜ in. border all round while it is being raised, this border being cut away afterwards. When the copper is starting to touch the hollow of the stake a series of blows may be commenced right close up to the edge. If a highly finished surface is needed, a steel punch of correct curvature is used, but the one illustrated was made throughout by the hammer (Figs. 16 and 20).

The bending of the feet is the next process, and care must be taken that they lift the body of the spirit lamp clear of the table. If the hole for the burner tube is punched with a saddler's punch, the punching may be carefully flattened (to avoid further spreading), and its thickness measured with a micrometer, and the alteration in thickness compared with the increase of area.

If ready-made tubing is not at hand, it is not difficult to form a tube out of thin sheet copper (26-gauge). If a drawplate is not available, the boring of a set of taper holes in a piece of mild steel will make one, and the copper may be roughly U-shaped by tapping into a groove, and then drawing through the taper holes will close the joint and leave it perfectly round (Fig. 14). Should the lamp be required for heating the Hero engine two wick tubes should be fitted.

The lower hemisphere has its edge "tinned" with solder before the two are put together, and they can be joined either with the soldering iron or by holding together in a flame. This latter method is called "sweating." The last processes are those of soldering the tube in and cleaning up with pumice powder.

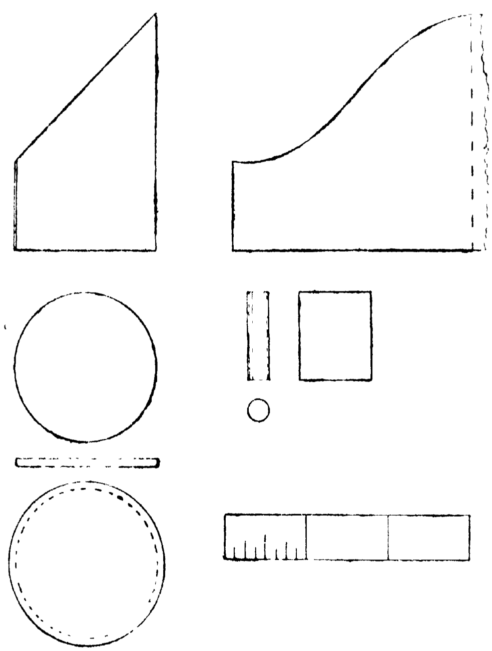


FIG. 6.

Small Scoop (Fig. 6).—Tinplate or either copper or brass may be used for this. It is interesting to vary the shaping of the end, showing that if the end, when developed, is bounded by straight lines, the resultant scoop will be curved in elevation, and vice

versa. Once the true shape of the development is secured, the making is straightforward.

The end should be made first. A centre punch dab should be made and a firm clean line scribed with the dividers. To ensure accurate cutting it is best to go round about $\frac{1}{16}$ in. outside the line, and then again right on the line.

Boys can usually cut more accurately with one side of the snips gripped in the vice, using sheet metal "clams" to prevent defacement by the teeth cut on the vice jaws. As the pressure in cutting is at the end of the free handle it is obvious that the under one should be gripped at the end. The edge can be turned up with the mallet, using the face of a hammer as a stake.

This is, however, a tedious job, and a better way is to take a piece of square steel ($\frac{1}{2}$ in. or $\frac{5}{8}$ in.) and to put a deep centre punch mark about $\frac{1}{16}$ in. more than the radius of the scoop from the end. With this as centre and the divider set to the radius of the scoop a line is scribed to which the end of the steel is filed. The arris should be removed, and the steel slightly bent so as to clear the edge of the scoop end when turned up.

The pip raised by the centre punch mark on the back of the sheet metal disc is now placed in the mark on the steel bar, and a series of light blows with the mallet, the disc being turned after each, will turn up the edge quickly and successfully.

Cutting the scoop body is the next process, and bending the body round any convenient cylinder follows. The body may be slipped inside the end while the seam is soldered, and then can be taken out and tapped with a mallet while on the beak of the stake, to bring it up truly cylindrical, before replacing and soldering in position. The tube for the handle may be made by drawing.

Another method is to take a piece of steel the inside diameter of the tube, and, laying the metal for the tube across the open jaws of a vice, tap the steel and the metal into the vice until half way in (Fig. 15). The vice must have smooth jaws The simple one shown is of wood, and answers capitally for sheet metal work. The vice is then tightened up hard, and the edges of the tube closed in. The end for the tube is cut large, soldered in place, and then trimmed off with a file.

Soldering the handle on needs care. A neat method is to put

a bead of solder inside, flux the scoop end, and then heat, till the solder shows outside, with a hot iron, cleaned but not "tinned." The scoop might rest on a piece of wood fixed upright in the vice while this is being done.

Hero Engine (Fig. 7).—Most of the work in this model has been covered point by point in previous problems. Tinplate is quite suitable for the boiler, and the corked hole, while not essential, is advisable to enable the user to empty the water out completely.

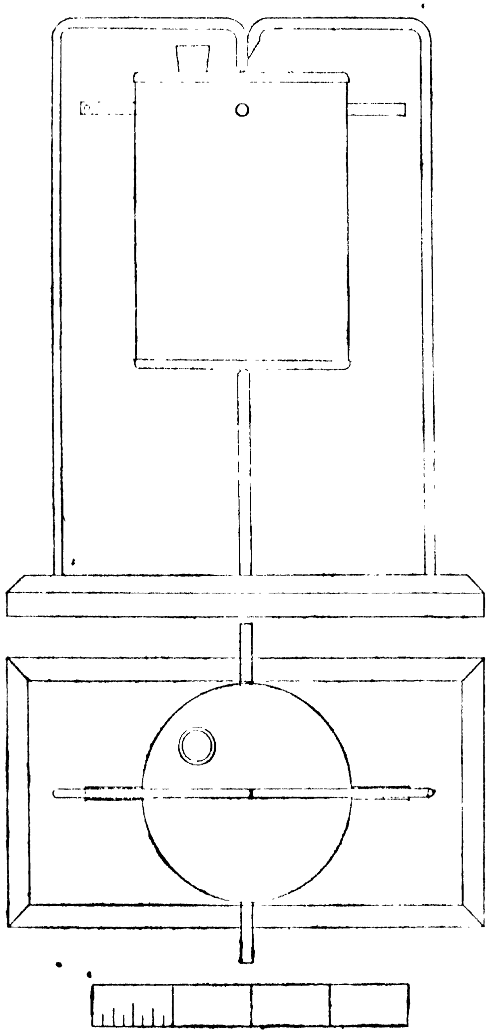


Fig. 7.

The points on which the engine turns should be carefully made. They should be as nearly perfectly conical as possible, since very little friction will prevent its working. The tubes should have their outer ends closed, and a hole about $\frac{1}{32}$ in. drilled close up to the end. The ends have their edges turned up as described in the last problem, and one should have a cork hole drilled, and a small tin tube, slightly coned, soldered over it.

The construction of the wire stand can be seen from the drawing.

It is made of $\frac{1}{8}$-in. tinned steel wire.

The variant of this model is Barker's Mill (Fig. 8), which differs considerably in construction. The inner tube has a plain lapped seam, and the outer one either a plain or a hooked seam. Before rolling into a cylinder the top edge of the outer tube should be folded over for about $\frac{1}{8}$ in. for strength, appearance, and to give an edge which can be safely handled. A pair of folding bars, made from a piece of $\frac{3}{4}$ in. × $\frac{1}{2}$ in steel, bent double so that the $\frac{3}{4}$-in. faces lie close together, is a convenient tool to use in bending either this edge or the edges for the seam.

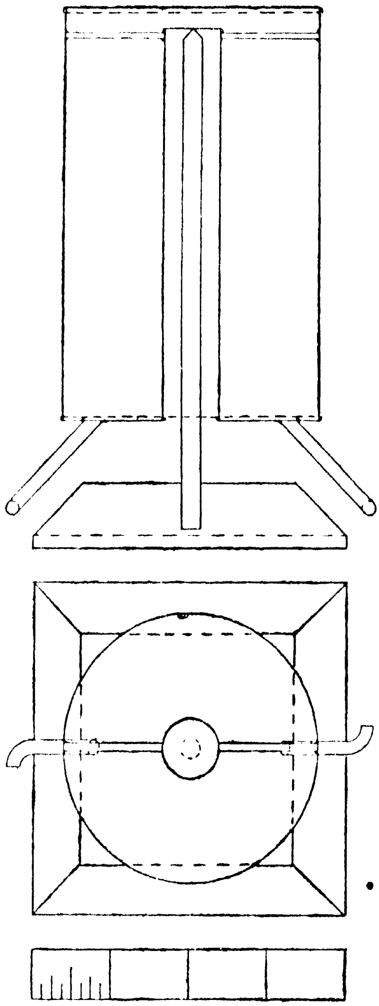


Fig. 8.

The illustration (Fig. 21) shows the method of use. The edges can, of course, be bent with the mallet over any convenient block if folding bars are not at hand. The bottom should have its edge turned up *before* the centre hole is bored, and the two holes for the jet tubes should be made next, as they can be used to keep the metal from turning whilst the centre hole is made with an old centre bit.

The proper tool for making holes in tinplate is a tinsmith's hollow punch, but the brace and bit will serve. Stubbly bits, retired from service in woodwork, can be used with little risk of breakage; but it is important that two stout nails or screws,

driven well into a thick piece of wood through the jet holes just mentioned, should be used, and that the brace be kept turning without hesitation just as the metal is pierced. This method of boring leaves an edge a little turned; in this case an advantage, as it is a help in soldering the centre tube in place.

The top of the centre tube may be a plain disc soldered in position and filed close afterwards, or it may have its edge turned up. In the latter case the centre pop comes the wrong side for the pivot, and should have a tiny drill put through and then a bead of solder fixed to make a bearing surface.

In assembling, the inner tube has its top put on first, and is then joined to the bottom. Next the outer tube is soldered to the bottom and the stay wires at the top are fixed, every care being taken to keep the two tubes concentric.

The holes in the bottom are prepared for the jet tubes by putting a piece of round steel in and forcing it outward to the angle required. The pivot is simply a piece of $\frac{1}{4}$ in. round steel, with a smooth conical point at the top, and is driven into the base, if this is made of wood. A lead base is better, and in this case the bottom end of the pivot rod is burred and notched before the lead is poured round it.

Zinc Glass Holder (Fig. 9).—The most important process in this problem is riveting. The method to be adopted is described in *Auxiliary Metalwork*, vol. ii., page 159. The problem itself is dealt with earlier in this article under the heading of "A Typical Lesson." No. 14 rivets and 20-gauge zinc are the materials.

Hall Lantern (Fig. 10).—This is another riveting problem. The one shown takes a bijou size inverted incandescent burner. The angle strips at the corners are made with the help of the folding bars, and in this case drilling is safer than punching in a boy's hands. Either a straight fluted, or a flat drill is better than a twist drill. If a twist drill is used it should be a short one. If not it soon will be, for the cuttings from copper are most tenacious. This lantern looks best in copper 22-gauge, though sheet steel, brightened with coarse emery cloth, is very effective until put into use.

The domed top is knocked up on a sandbag with a plumber's mallet with egg-shaped head. An easy alternative is the use of

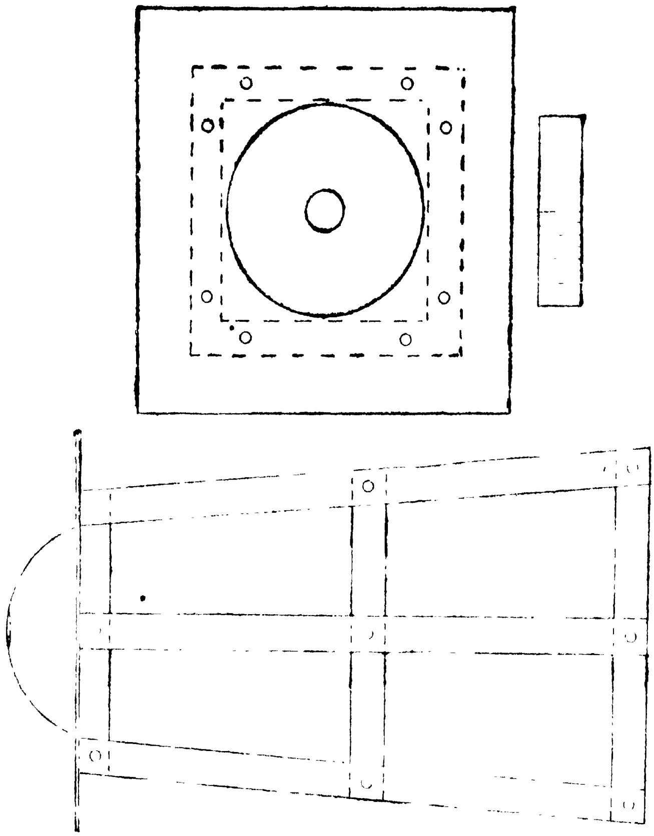


Fig. 10

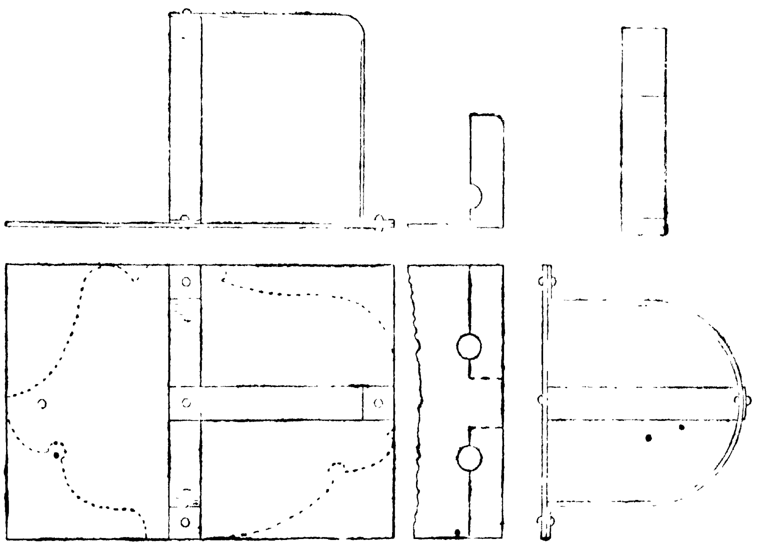


Fig 9

curved strips, which also simplify ventilation. If glass panels are desired the strips forming the sides should be left long enough to turn over and clip the glass (Fig. 17).

Convection Toy (Fig. 11).—As the power available from convection currents is very small every care must be taken to ensure free working of the parts of this toy. As it is exposed to heat the soldering must be well done, and, where possible, be assisted by some other fastening. The figure is cut out of sheet metal, tinned plate being most suitable. The joints are fixed either with eyelets or rivets. The former are obtainable at boot repairers, and are really tubular rivets. They are put through the holes and then expanded with a centre punch and closed down with a light hammer until the joint is without shake but still quite free.

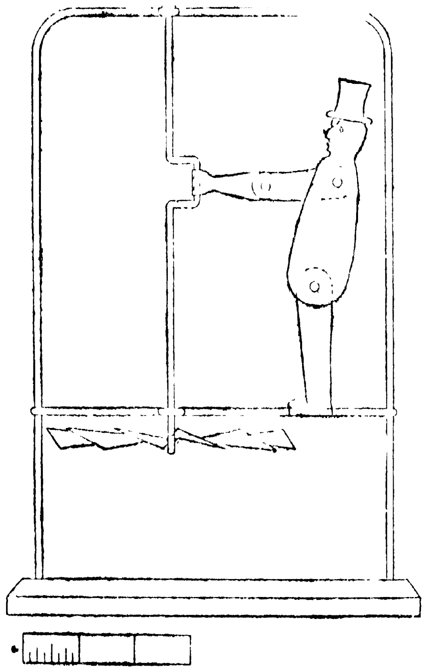


Fig. 11.

If ordinary rivets are used it is a good plan to put a sheet of paper between the two pieces of metal and then to solder the rivet into position. The paper can then be torn away, leaving a free joint. Whether rivets or eyelets are used, all "burr" must be cleared from the holes.

The feet of the figure should be curled round the wire on which it stands, so as to give ample soldering surface. The crank is the only difficult part to make. It is essential that the wire should be straight, and that the crank pin should be parallel to the shaft. The bends at the ends of the crank pin are made first, making a sort of elongated U, and this is put in the vice with a piece of packing between while the two parts of the shaft are bent.

The propeller is simply a disc with radial cuts, each sector being twisted through about 35°, with the pliers. The bearings are loops in the wire. At the top a ring of wire is soldered on the shaft to take its weight and that of the propeller, or else the shaft may be made from a perambulator spoke, which has a head ready formed. The propeller is held by a turn in the wire and by solder. The toy may be made to fix over a kitchen gas burner, when it acts as a ceiling protector. The materials are tinned plate and $\frac{1}{16}$-in. tinned steel wire

Small propellers on similar lines may be made to indicate the upward and downward currents in the convection box used to illustrate mine ventilation, etc. In this case they are made with a small hole and revolve on the head of a pin passed through them. Another form of propeller is spiral in shape

Expansion Gauge (Fig. 12).—This is a familiar piece of apparatus, but the further familiarity reached after making it results in anything but contempt. The standard of accuracy required is high, because the linear expansion of the brass rod is only about $\frac{1}{100}$ in. The opportunity should be taken to explain the difference between accuracy to standard and accuracy in relative size. The latter is, of course, sufficient here, but it is important that pupils should grasp the limitations of such a method of working. This problem may be varied by making the bar with two gaps, one on either side. The rod should pass one gap and not the other, and with this the modern system of working to limit gauges can be explained

The actual making is simple, though not easy. The rod is of $\frac{1}{4}$-in. or $\frac{5}{16}$-in. round brass, and the handle of 16-gauge tinned wire. The ends of the rod are made slightly convex. The bar is of 1 in. × $\frac{1}{8}$ in. or $\frac{3}{16}$ in. steel. The opening is marked by scribed lines with centre punch dots along at $\frac{1}{2}$-in. intervals. A $\frac{3}{16}$ in hole is drilled at each corner, and a hack saw cut made down to the hole, but clear of the line.

The waste is then taken out in one piece by gripping the bar in the vice, just above the line, and cutting with a hammer and flat chisel (Fig 19). The action is more that of shearing than cutting. The chisel edge should make an angle of about 15° with the face of the metal. The long side of the opening is trimmed and taken down to the line with the file. If the single gap is

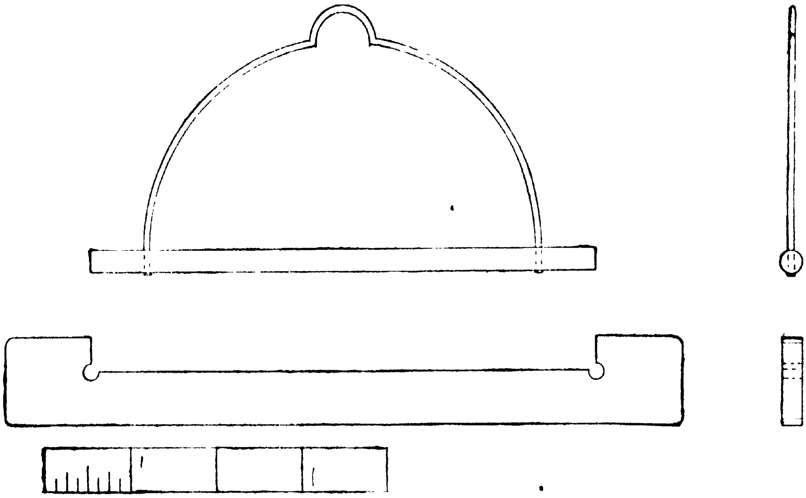


FIG. 12.

being made it is easier to fit the rod to the bar, but in the other case the rod should be finished first.

For the final finishing of the fitting surfaces a piece of fine emery cloth should be used, glued on a wood back ; but previous to that all sharp edges should be removed and the flat surfaces "drawfiled." In drawfiling the work is fastened down on a flat piece of wood with small brads, and the file is held *across* the work and moved along it (Fig. 18).

Tools.—Metal vices (one to about five boys) ; flat, half round, round, triangular, and square files; small and medium ball-paned hammers; beak iron (a small anvil with a square stem to fit into a hole in the bench) ; cutting pliers, round-nosed pliers ; 8-in. and 10-in. tinman's snips ; rivet sets ; bossing and tinman's mallets, hide mallet; soldering irons; hacksaw frame and saws; flat chisels ; centre punches ; drill stock and drills ; folding bars.

Materials.—Sheet copper and brass of 22-gauge ; zinc 20-gauge ; tinned plates ; copper wire 16-gauge ; tinned wire 16-gauge and $\frac{1}{8}$ in.; steel wire $\frac{1}{8}$ in. ; tool steel and mild steel $\frac{1}{4}$ in. diameter; brass rod $\frac{1}{4}$ in. diameter ; mild steel 1 in. × $\frac{3}{16}$ in.; tinman's and copper rivets; solder ; emery cloth.

Cost.—About £5 for twenty boys for equipment. About 2s. per boy per annum for materials.

The Use of Ordinary Domestic Waste, etc.—For regular class-work the equipment suggested above is necessary, but good work, from both educational and technical standpoints, can be achieved with very little expenditure either for tools or materials.

The expenditure of teacher's time and energy is correspondingly increased, and this expenditure is justified only when the interest of the object to be made is exceptional, or where its purpose is illustrative and its need immediate. No condition of administrative economy can justify the attempt to work continuously on these lines with a full class, indeed it is not possible, apart from the waste of the two most expensive elements in a school—teacher and taught.

However, speaking of materials, there is much that can be done with ordinary domestic waste. Empty tin canisters furnish a supply of tin plate of good quality, though rather thin. Coffee canisters yield quite a good piece if the bottom is taken off. This can often be done by filing through in one place to get a start, and then turning back the clinch with pliers. Such problems as the Hero engine and Barker's mill can of course be made very quickly from canisters. Lever lids make good bases for small mechanical models. The smaller ones can be soldered on a straight wire to make wheels. Knitting needles are made of steel sufficiently good to serve for scribers, drills, etc Discarded sash fasteners, locks, etc., provide small pieces of sheet brass, and a wealth of material is found in old gas fittings Incandescent burners provide tubing, the by-pass type having a very small tube. Meat skewers and hair-pins give a fair range of wires, toy soldiers and tea-chest linings a supply of lead, and packing cases give strip iron. For tools, a good-sized flat iron is a convenient substitute for the anvil; soldering *can* be done with a poker. Milliners' pliers can be found in many homes. Adjustable cycle spanners are useful for wire bending at right angles, and bottles and jars serve for bending circular curves.

BOOKS FOR REFERENCE

Soldering and Brazing (Dawbarn & Ward, Ltd.). *Metalworking Tools and Their Uses* (Percival Marshall & Co.). *Simple Mechanical Working Models* (Percival Marshall & Co.).

XXXVIII. REPOUSSÉ WORK

By J. W. Wilkinson, A.S.A.M.

Teacher at the School of Art, West Bromwich, and at the Barry Summer School; Art Master and Medallist, South Kensington; Silver Medallist, and Honours in Goldsmiths', Silversmiths', Metal Plate Work, City and Guilds of London Institute, Distinction in Repoussé Work, Metal Work, etc., Board of Examinations for Educational Handwork.

Educational Value.—The chief claims of repoussé work to be considered as an educational medium lie in its appeal to the senses of sight and touch, and in its powers of developing the æsthetic and imaginative faculties. Introduced at a suitable age, about twelve or thirteen, and taught with reference to the ability of the pupil, it is capable of developing individuality and allows plenty of scope for invention and self-expression.

The natural desire to create is fostered, and the pleasure in executing useful articles suitably ornamented sustains the interest, whilst the motor faculties are exercised by the various operations involved in tool making, preparation of the work, and "making up" the articles. In the hands of a sympathetic teacher this subject is distinctly educational and formative, besides being useful for its own sake.

Correlation.—Repoussé work may be taught as a separate subject, in which case the "making up" would necessitate many processes in light metal work, but probably its most extensive use would be in connection with courses in metal work, where articles needing some form of decoration could be suitably enriched with tool work, tracing, or repoussé work proper. A knowledge of this subject would also be useful to the craftsman in wood, who would be able to make and decorate the metal fittings, thus combining practice in metal work with wood-working and extending the scope and interest.

It is, of course, closely related to drawing and modelling, and

as a means of developing the usefulness of these subjects it takes an important place among the crafts. As both geometrical drawing and nature drawing can be utilised in the formation of designs, the application of studies in the drawing and modelling classes to execution in a more permanent medium, has distinct value in stimulating the pupil to greater effort, and affords additional drawing practice without the repetition becoming irksome.

Place in Curriculum.—This subject is of course most suitable for seniors. The small punches which are so largely used throughout the work require firm muscular control, and the movements are slow and confined to a small space. Therefore young pupils should have exercises in simple pattern making with various punches, and designs with large masses

In the primary school the work may be introduced at the age of thirteen or in connection with metal work at twelve, in which case it gives variety, adds interest to mechanical processes, and encourages initiative. In secondary schools it would prove a most useful hand and eye training medium, and as it is so closely allied to drawing and modelling, it naturally takes its place as a complement to those two most necessary subjects.

Where there is no equipment for wood work or metal work, repoussé work forms an excellent substitute, if provision is made for the technical processes of "making up." This subject has now a recognised place in the curriculum of the Art School, and is becoming increasingly popular Here the craft finds its most congenial surroundings and is capable of the highest degree of finish of detail and variety of treatment. It may be taken as a preparatory vocational subject, or for its usefulness in developing the appreciation of line and mass, surface treatment, and the application of ornament consistent with the processes, materials, and uses of the objects made (see Plate XXXV.).

History.—The history of repoussé work as a craft, extends back to remote ages. The Jews have left on record the use of this form of decoration in connection with various sacred vessels of the Tabernacle and the Temple. Our national museums contain examples of ancient metal working of a high degree of skill, the craft being known to the Assyrians, Egyptians, Greeks, and Romans. Italy produced many fine works during the sixteenth and seven-

teenth centuries, the most notable craftsman in artistic metal work being Benvenuto Cellini, who lived from 1500 to 1570. In modern times the best known work is that from the hands of Ladeuil—i.e. the "Milton Shield," the various divisions of which illustrate the poet's "Paradise Lost."

Characteristic Features.—Comparison with other methods of decorating metal emphasises the characteristics of repoussé work. Engraving consists of fine, sharp, incised lines, is suitable only for small objects and its beauty lies in the delicately drawn outlines. Enamelling relies upon colour effects, whilst repoussé work gives a surface decoration in which the play of light and shade is the most important feature. Soft modelling is most suitable, and harsh surfaces should be avoided; contrast being obtained by the outlines, by careful use of mass and detail, and sometimes by varying the texture (see Plate XXXVI.).

The term "*repoussé*" is from the French (*re*, and *pousser*, to push) and means embossed by hammering from behind and afterwards finished by chasing. The latter term (chasing) is also used to describe the process of modelling the surface of cast metal.

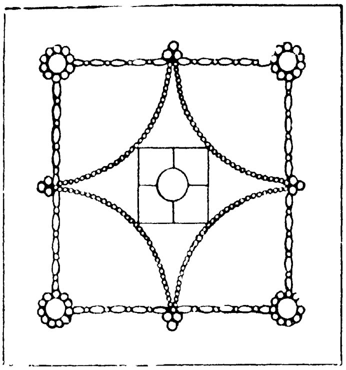
General Principles.—In this article the object is to show how this subject may be treated from an educational point of view, either as a self-contained subject, or supplementary to other forms of handwork; at the same time the exercises also form a sound basis for the more complete study of the advanced stages of this interesting craft.

The encouragement of individuality should receive attention from the earliest exercises, and as this work allows plenty of scope for invention, the creative powers of the young pupil should be fostered side by side with the development of technical skill.

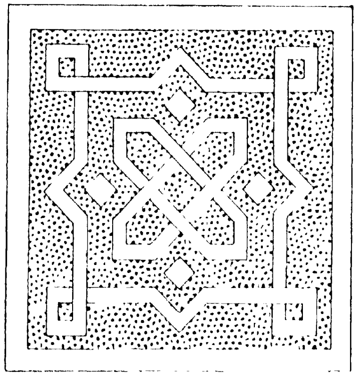
In order to reduce as far as possible the call upon his ability to control a rather difficult tool, it is advisable that the early exercises should consist of arrangements of tool impressions, which form a very effective method of decoration; and, as it is only necessary to hold the tool upright, more attention can be given to the method of using the hammer, and to the effect of each blow.

Interest, always a potent factor with the young, is sustained by the results so easily and quickly accomplished. There is no

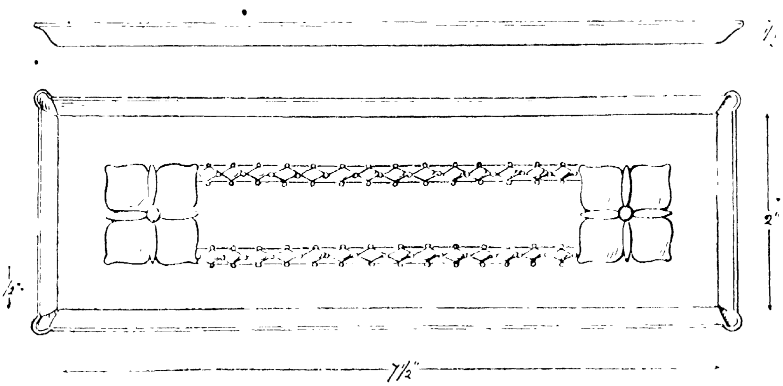
Nº 1. MAT. Brass. 5 M.G



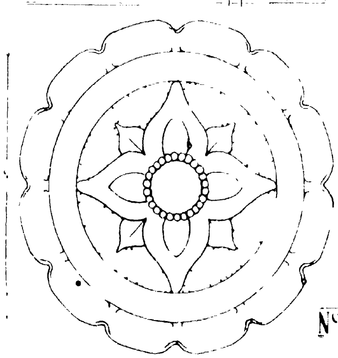
Nº 3. TEA-POT STAND Brass 8 M.G



Nº 2. PEN-REST Brass. 5. M.G.



ASH-TRAY. Copper 8 M.G



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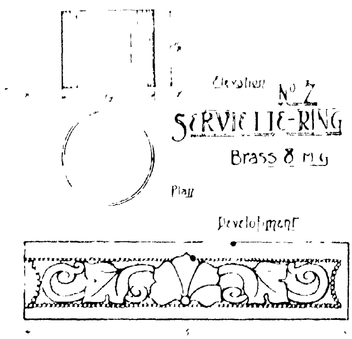
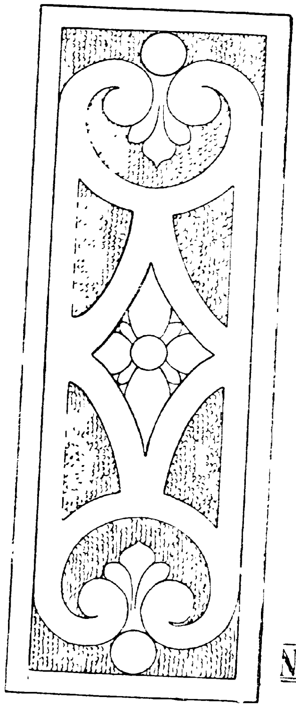


Nº 4 SERVIETTE-RING

Brass 8 M.G

S.H.

FINGER-PLATE Brass 8 MG.



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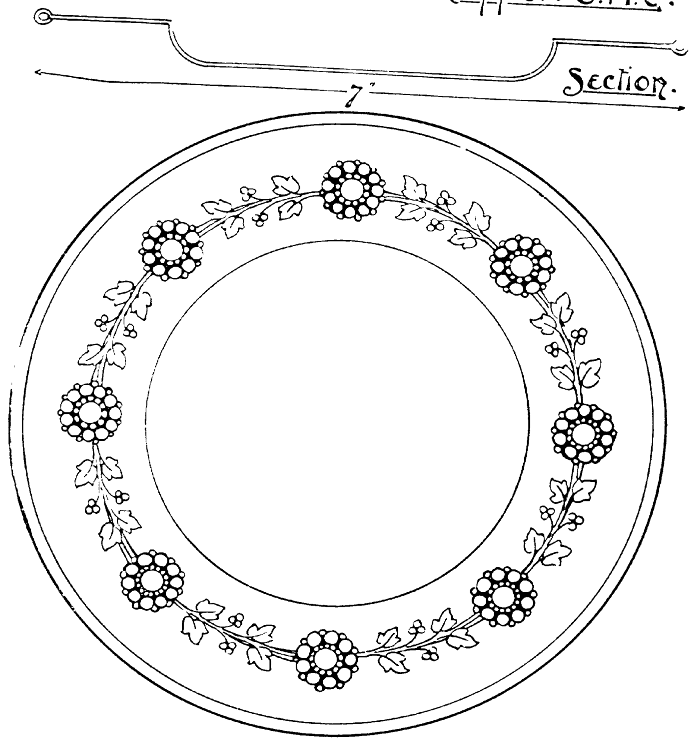
No. 8. PLATE. Copper. 8. M. G.



need for transferring designs in this stage, as a few geometrical guiding lines drawn directly on the metal are all that is required.

Plate XXIX. illustrates specimens of this method by pupils of twelve and thirteen years of age, the geometrical arrangement being suggested by the teacher, which the pupil carefully draws with instruments on paper as a preliminary to setting out on metal. He makes his own selection of tools after trial upon a piece of waste metal, the tools in this case being limited to three or four sizes of pearls, ring tools, and tracers.

Having become familiar with the use of the tool as a punch, he will probably be interested in making a tool which he could shape to suit his own design in the next exercise; and will by experimenting with various combinations of these tools, become almost unconsciously initiated into the rudiments of design, by building up units on a geometrical basis. He is impressed with the simplicity of the methods used, and his mind is free to exercise his ingenuity in getting various effects by the ordered disposition of line and mass.

Next would follow the use of the straight and curved tracers, in patterns combining these with tool impressions, which would be designed with only short straight and curved outlines.

So far the work has all been done on the back of the metal and the next exercises would give practice in outline tracing on the front, the ground being punched with a medium sized pearl to relieve the masses of the ornament.

It may be interesting to note here that at this stage quite a good effect may be obtained without the use of the pitch block, a block of planed birch about two inches thick being used instead, and the metal fixed to the surface with oval wire nails. These should be placed about one-eighth of an inch away from the edge, and at intervals of about one inch.

The reason that the nails should not be fixed close up to the edge is because during the process of tracing the metal stretches, and the space allows room for this expansion.

The nails are bent over on to the surface, of the metal and the work should be commenced at the centre and carried towards the edges.

Plate XXX. shows the style of design suited to this method—

the spaces between the outlines must not be too narrow, the forms being kept large and simple. The work has all been done from the front except the seed, which were executed from the back with a pearl tool, the metal being laid upon a pad of lead. Although the leaves appear in relief no raising was done on the back, the effect being the result of tracing the outlines and punching the background with a small pearl, which causes the metal to pucker up in the masses of the design.

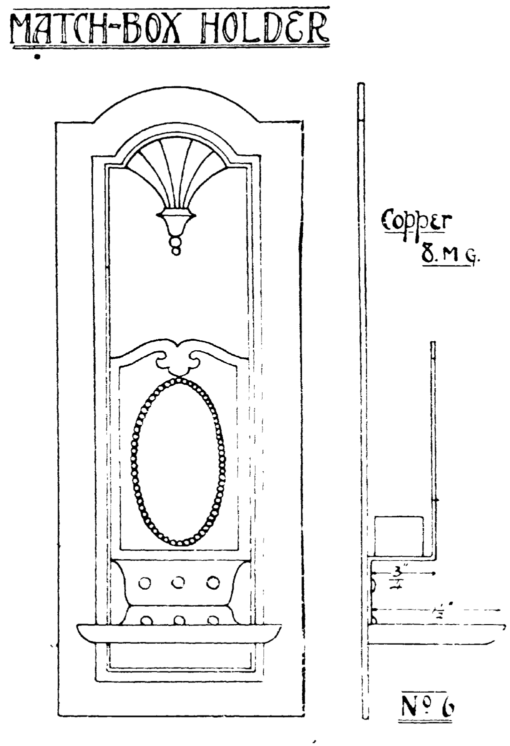
Having introduced the tracer, which should be thoroughly mastered before proceeding with the raisers, etc., there is very little difficulty experienced in using the tools required in obtaining the relief, at least so far as the effort to guide the tool is concerned. It is in the selection of the most suitable tool and knowing where to direct the blows that the most skill is required. Here it is a question of taste and judgment to get the best effect in modelling the relief. The succeeding exercises show some of the methods of treatment with a description of the various stages.

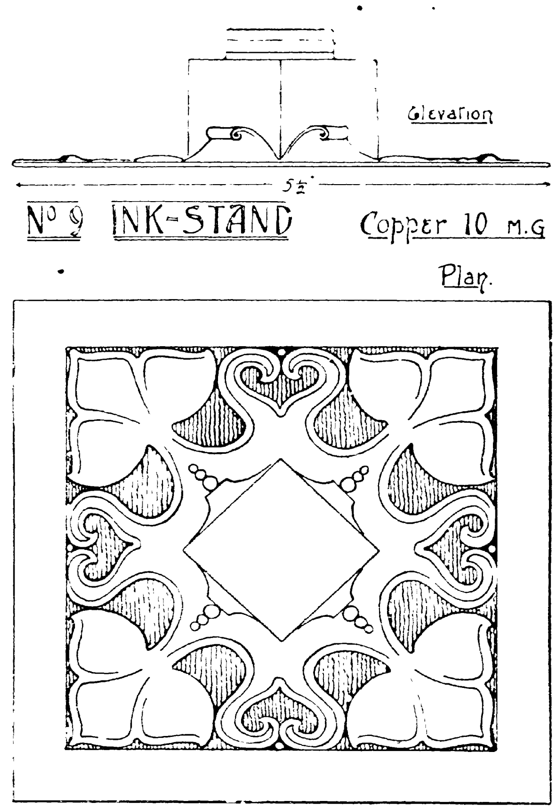
The decoration of the surface should in no way interfere with the utility of the object, which should always have the first consideration. Conventional ornament is most suitable. Harshness should be avoided, full advantage being taken of the metallic lustre when designing the pattern, which should form a contrast to the plain surfaces, one acting as a counterfoil to the other.

The Teaching of Design.—As suggested above, the pupils should be encouraged to invent their own designs from the commencement, and not merely make a copy, though examples of what is required should of course be provided.

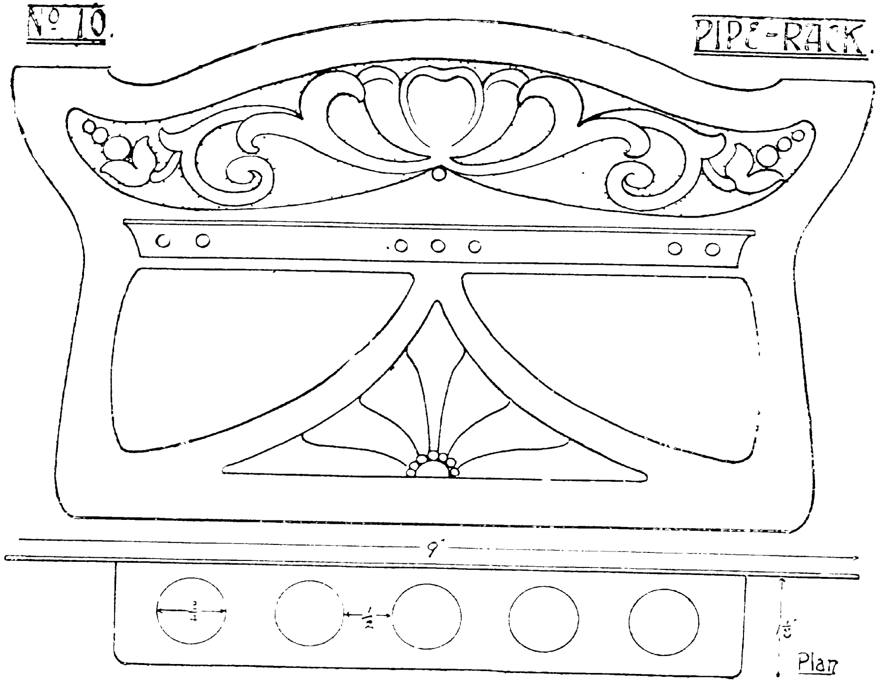
Plate XXIX. illustrates the first step, and a start may be made by allowing the pupil to experiment with two or three repoussé tools on thin sheet brass. He is shown that by simply arranging the tool marks in groups, interesting patterns may be formed, giving a variety of effects according to the tools selected, and the manner of grouping.

Having made a few samplers, he may be required to set out a simple geometrical shape, and, choosing one of his own patterns, use it to form a border. A centre rosette may be made by grouping some of the tool marks in a circle, as in the design for a plate, No. 8, Plate XXVI.


MATCH-BOX HOLDER
Copper
8. M G.
3/4"
1/2"
No 6


Elevation
5 1/2"
No 9 INK-STAND
Copper 10 M.G
Plan.

No. 10. PIPE-RACK.



The pupil realises at once that it is possible to make endless combinations, and he is stimulated to further attempts when he finds that not only can he manipulate the tool with ease, but also that he can obtain pleasing results of a useful character in a permanent material, by exercising his own ingenuity.

The next step would be to set a problem in the suitable application of these units—i.e., a pin-tray might be suggested; the shape, dimensions, and ornament being determined by the pupil. This process could of course be extended to the decoration of many other objects such as finger-plates, match-brackets, photograph-frames, boxes, etc.

The idea is now grasped, that, however intricate a pattern may be, it is built up of units. But these units must have some relation to each other, and the following exercises should lead to the consideration of spacing, proportion, and the value of a plain surface as a relief and contrast to the decorated portions.

A geometrical basis is the most suitable for the ornament at this stage (see Plate XXXIII.).

Line, form, and modelling are best taught by reference to nature. Studies of plant and animal life offer rich suggestions, but in the transition stage (between exercises composed of tool impressions, and those of modelled decoration) the patterns may consist of a combination of geometrical outlines, and conventional renderings of flowers, leaves, etc., as in the Finger Plate (No. 4, Plate XXVI.) and Ash Tray (No. 5, Plate XXV.) (see also Plate XXXIV.).

As the power of observation grows, and more skill in drawing is acquired, the decoration may become more intricate and the modelling more refined.

The form of the units may change, but the principles of construction remain the same; though attention must now also be paid to proportioning of details and subordination of the parts to the general scheme. The use to which the object will be put should always receive first consideration, and control both the shape and the decoration (see Plates XXXIV., XXXV., and XXXVI.).

Typical Exercises.—*A Square Mat.*—This provides a useful introduction to the method of fixing the metal and using the hammer. Prepare the metal by cutting out material rather larger than the design, and flattening upon the hard wood block

with the mallet, taking care that the blows are so directed that the metal is not bruised.

If the metal is not specially prepared it must now be annealed, and cleaned in the acid bath, and scoured with powdered pumice and water, as described later, or with fine emery cloth and a drop or two of oil. Wipe off all trace of oil, when clean, with a rag or cotton waste moistened with turpentine.

The metal may now be fixed to the pitch block. This is easily done with a blow-pipe, a bunsen burner, or a piece of iron pipe attached to a length of flexible tubing may be used, the end of the pipe being slightly flattened to give a spreading flame. This is generally the best arrangement for young pupils, as with this flame they are not so liable to burn the pitch when the latter is being melted (see Plate XXXI.).

Avoid overheating, and consequently blistering the pitch. When this is melted over a surface giving a good margin around the plate, warm the metal and press it on to the surface of the warm pitch, taking care not to let it run over the metal.

Put the block with the metal in position on one side to cool, or, if it is necessary to proceed with the work at once, allow cold water to run over it until sufficiently cool. Now proceed to set out the design which in this case may be drawn directly on the metal with the scriber and dividers—the geometrical arrangement being all that is necessary.

Select a medium sized pearl and, holding the tool vertically strike lightly with the repoussé hammer, which should be held well-balanced but rather loosely, working only from the wrist and giving an elastic blow. As the tool is moved along care should be taken to keep to the line, and to have the tool impressions as even as possible. Follow up with a larger pearl in the corners and centre of the sides, and then with a blunt tracer line in the small square in the centre.

To remove the metal from the pitch place a small chisel under the edge and, with a light tap of the hammer, the metal may be easily forced off if the pitch is cold This is the best way to remove the metal and gives less trouble to clean, but if the pitch has been recently warmed, then the metal does not readily leave the block, and it will be found necessary to warm the

plate with the blow-pipe and pull the metal off with a pair of pliers.

The metal must now be cleaned by gently warming over the bunsen flame and wiping with cotton waste soaked in paraffin oil. Care must be taken not to burn the pitch on to the metal, which would make it much more difficult to remove. The mat is now carefully flattened out on the hard-wood block with the mallet, cut to size, and the edges filed (see Plate XXIX.).

Pen Rest.—This type of model forms a transitional stage between patterns composed of tool impressions and those which involve the use of the tracer in a continuous outline. The examples in Plate XXIX. illustrate what may be done.

The tracer is used for short straight lines, and curved tracers are used as punches to make up a composite curve. This would also be a suitable stage at which to make a punch which could afterwards be used in the exercise

Cut a piece about 4½ inches in length from a rod of cast tool steel—which can be purchased in either square, circular, or hexagonal section—anneal by heating to a cherry-red and allow it to cool gradually, when the steel may be filed to the required shape, hardened by heating as before to a cherry-red and plunging into water, and then tempered to pale straw colour. The tool is finished by burnishing upon leather with flour emery. After the decoration, which is all worked from the back, is completed, the metal is cleaned, trimmed, the edges set out, and the corners filed round ready for bending.

This may be done by taking a pair of round-nosed pliers and gripping the metal about a quarter of an inch from each corner, then bending the metal up sharply, the remainder of the edge being turned up by resting the metal upon the edge of a block of hard wood and striking it over with a mallet The corners are now worked into shape, either with pliers or by placing in a notch or groove filed in the edge of the bench or block of wood, and hammering it to shape with the ball peen of the repoussé hammer.

This and the preceding exercise may be worked in No. 5 metal gauge (26 Standard Wire Gauge)

Teapot Stand.—This exercise is designed to initiate the pupil into the use of the tracer, and affords the necessary discipline

before proceeding to the use of other tools. Plate XXXI shows the correct method of holding this tool, the third and fourth fingers being pressed hard upon the surface of the metal near the end of the tool, the thumb gripping the tool midway between the first and second finger.

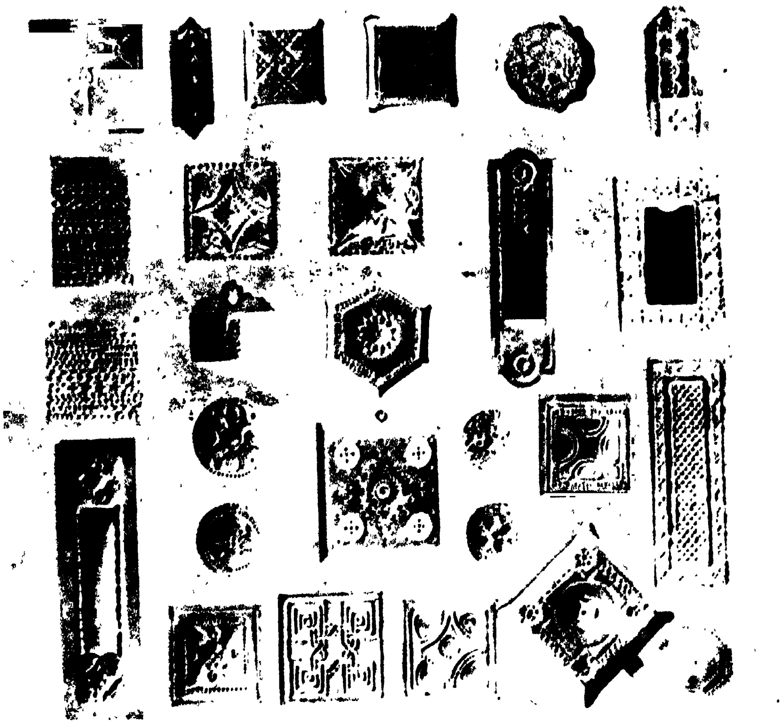
The tracer is held firmly in contact with the metal and slightly out of the vertical (leaning away from the worker), so that when the tool is struck with the hammer on the near edge of the top, the tool not only indents, but also when rapidly struck with a succession of light blows, slips along the surface of the metal, making a continuous line instead of detached impressions as in the previous exercise

Commence at the farthest end of the outline and direct the movement of the tool towards the worker. If the work is adjusted so that the light falls in front of the tool and from the right there will be no difficulty in following the outline of the pattern. The tool should not be pushed, but held in contact with the metal and given the proper direction, the blows from the hammer impelling the tool forward. The thick oval end of the handle rests against the palm of the hand and the forefinger rests upon the taper part, the fingers and thumb forming a fulcrum must not grip the hammer tightly but allow it to swing freely. All blows are to be worked from a wrist movement only (see Plate XXXI.).

It is important that the correct method of holding and using both hammer and tracer should be acquired at this stage, as the successful manipulation of the other tools largely depends upon the mastery of the tracer.

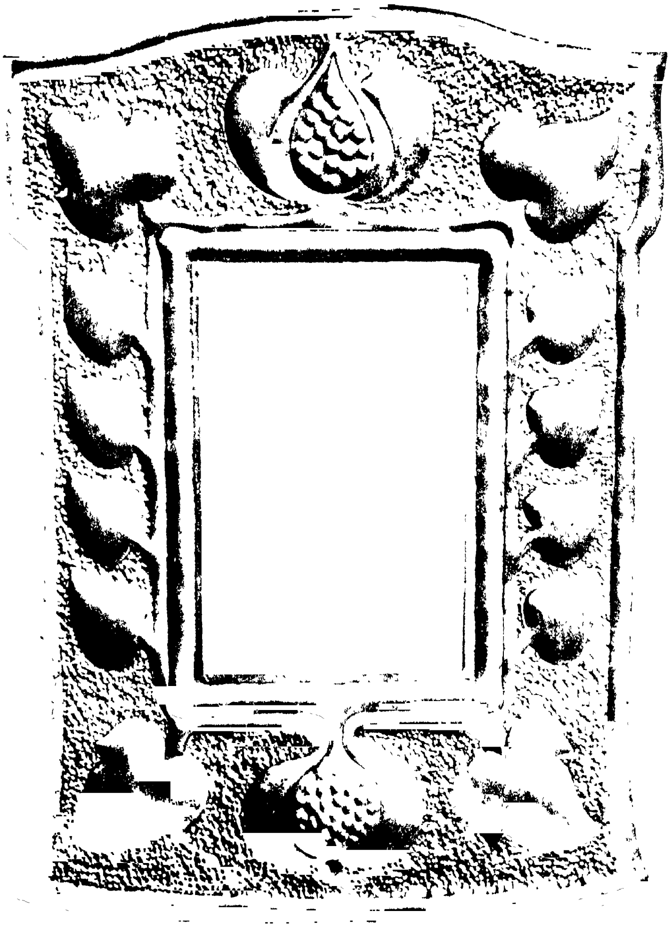
The ground may be either left plain or gone over with a pearl, which affords a strong contrast to the plain masses, breaking the surface up into tiny hollows which catch the light and give a different texture to the metallic lustre.

The pearl is used here rather differently from its use as a punch in making patterns. Instead of isolated blows the hammer is tapped rapidly and the tool moved along vertically, the aim being to get a regular even surface but not a mechanical appearance. A great variety of effects may be obtained by using different sized pearls.



ELEMENTARY EXERCISES. EXAMPLES OF DESIGNS FORMED BY TOOL IMPRESSIONS.

PLATE XXX



PHOTOGRAPH FRAME EXECUTED WITHOUT A PITCH BLOCK

After cleaning the metal the edges are trimmed with shears and file, the corners cut across at 45° to allow for bending the edges over for wiring. This may be done by resting the metal against the edge of a block of wood and knocking gently over with the mallet, when a length of No. 13 S.W.G. brass wire can be placed in the bend and the edges pressed round the wire, using a piece of wood as a punch or hammering into a groove in the grooving stake.

This not only adds to the appearance, giving a rounded edge, but also considerably strengthens the panel for use as a tea-pot stand. The metal for this exercise should be thicker than that used for the two previous models, No. 8 metal gauge brass being suitable (see Plate XXXIII.).

Finger Plate.—Practice in tracing curves is the feature of this exercise, and the pattern is designed to give a variety of curves with the lines spaced a fair distance apart. The straight tracer is used for the bolder sweeps, curved tracers for the quicker curves, and ring tools for the circles.

The concave side of the line should be towards the hand holding the tracer, and the pitch block should be moved around so as to bring a fresh series of lines and curves into the position occupied by those just done. On the curves of small diameter the tool should be tilted more on to its cutting point and struck more rapidly than when tracing larger curves, but without allowing the tool to travel any faster. When the outline is complete the ground should be matted, the metal cleaned and trimmed to size, holes drilled or punched to take the screws for fixing, and the edges slightly rounded over. Use No. 8 metal gauge brass which is about No. 22 in the Standard Wire Gauge (see Plate XXXIII).

It will be necessary in this exercise to transfer the design on to the metal. This is done by making a tracing of the drawing, which is fixed to the metal with some adhesive at the corners or held down with a weight, and a sheet of blue transfer paper placed between the tracing and the metal; then with a dull-pointed stylus the lines of the pattern are gone over with a firm hand. As the transferred drawing is liable to be erased the outline is now scratched in with a scriber, to secure the lines in case the transfer is rubbed off.

Ash Tray.—Copper No. 8 metal gauge would be suitable for this model. The outline having been traced on the front, the metal is removed from the block, cleaned, and replaced face downwards upon the pitch, and whilst this is still warm raise the centre boss and the middle of each petal with a large brass raising tool, working from the centre and getting the relief gradually.

Now go around the outline of the petals with a narrow steel raising tool, depressing the metal just within the edge of the forms which will be easily seen, the lines which have been traced from the front showing as a raised line on the back. Hold the tool much in the same manner as when tracing, but more perpendicularly, slipping it slowly along by means of the second finger, without lifting the tool off the metal. If this is properly done the result will be a smooth hollow; but probably the first attempts will look like so many bruises, until the learner gets the knack of gliding the tool along in conjunction with rapid but even blows from the hammer.

Of course these hollows will show in relief on the front, and when the background is punched over on the front this relief will appear still more prominent, as the ground is slightly sunk in this process. This modelling gives more interest to the forms, but only simple raising is aimed at in this exercise, so as to give an opportunity to concentrate on the proper method of slipping the tool along in sympathy with the hammering.

To finish the tray first straighten out with mallet, cut to size with shears and file up the circular edge, then having struck a circle with wing compasses, about half an inch from the edge, divide this up into regular divisions about 1 in. apart. Now take a pair of round-nosed pliers and holding as in Plate XXXII. (*right*) at right angles to the circumference and with the tip of the pliers resting on the inner circle, bend the edge up slightly at each division.

Repeat this until the edge is raised nearly at right angles to the flat surface of the tray, then, holding the tray in the left hand as in Plate XXXII. (*right*) against the edge of the bench, or a block of wood held in the vice (in which a shallow groove has been filed), hammer the metal between each division with the small end of a bossing mallet, giving it at the same time a slight curve over.

Adjust with the pliers, and repeat with the bossing mallet until the edge of the tray is satisfactory. This method forms a very decorative finish to the edge and at the same time considerably strengthens the tray (see Plate XXXIII.).

Match Box Holder.—Made in No. 8 gauge copper this makes a very interesting exercise in simple raising and making up by riveting, etc. The outline is traced upon the front as before, then the metal is reversed upon the pitch block. Commence the larger masses with brass raising tools whilst the pitch is warm, the smaller masses are sunk with suitable steel raising tools as the pitch gets cooler. The large oval boss may be raised, either by using a large boxwood punch upon the soft pitch, or, by resting the front upon a leather sand bag, the relief may be obtained by hammering as in Plate XXXII. (*left*), using wood or brass raising tools.

The centre of the panel and the plain surface around the oval boss may be lightly hammered over with a small planishing tool which gives a pleasant texture to the surface To do this the metal should be remounted upon the pitch block face upwards, allowing the pitch to set cold before commencing to use the planisher. The appearance would also be improved by going over the outlines again with a tracer

Punch or drill the holes for the rivets, trim and bend the edges back, bend the front piece and solder or rivet a small strip of metal behind to push up the matches when the box is placed in position; then rivet to the back by burring over the edge of the shank of the rivet with the peen of a riveting hammer and finish off with a riveting set this is a round steel punch with circular hollow at the end to place over the rivet to round it up (see Plate XXXIII.).

Serviette Ring.—This exercise introduces finer detail in the tracing and raising. To find the length of the strip of metal (No. 8 gauge brass) required, multiply the diameter by three and one-seventh, allowing about ⅛ in. for the overlap required to make the joint.

The raising must be very slight and when complete, and the edges trimmed and filed, the strip is pressed on the back with the cylindrical part of the mallet head, resting the metal face down-

wards upon the leather sand-bag. The mallet is rubbed backwards and forwards until the strip takes a curve, when it is further worked into shape upon a cylindrical mandril (a piece of hard-wood roller, or iron gas-pipe held in the vice would do), by tapping with the flat face of the mallet. Bring the edges together and solder the joint, being careful to see that the parts to be soldered are filed or scraped perfectly clean.

Flux the joint with chloride of zinc, made by putting small cuttings of zinc in an earthenware vessel containing hydrochloric acid (spirits of salts). The soldering iron should be nearly, but not quite, red hot. Picking up a little tinman's solder with the bit, tack the joint at the two ends, and then draw the iron along the seam. Plate XXXII. shows the soldering iron in use. Rinse in hot water to get rid of the salts which would corrode the metal if left on. Place the ring upon the mandril and correct the shape; the edges may be turned back at intervals with the pliers as shown in top illustration.

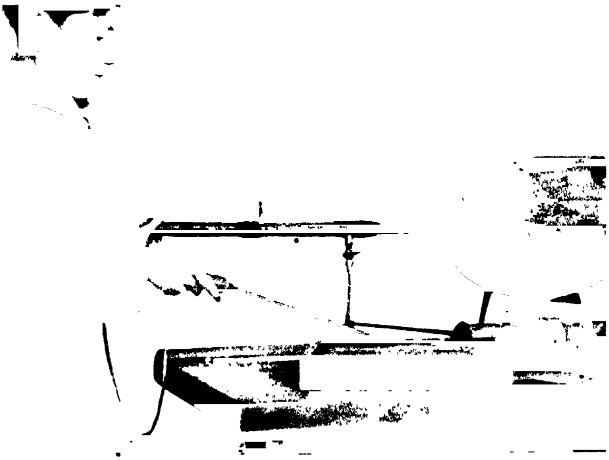
A Plate.—Take No. 8 gauge copper, cut a circle and file up the edge. Strike the inner circle with steel compasses and resting the disc upon the sand-bag as shown in Plate XXXII.; beat the part to be hollowed with a bossing mallet, working the disc around in a circular direction with the left hand.

The illustration shows the method of commencing the beating up of a bowl, the mallet being worked in concentric circles, but the small end of the mallet should be used to start the hollow of the plate, which should be begun near the circumference of the inner circle. The rim of the plate is occasionally flattened as also shown. Use at this stage a flat-faced mallet instead of the planishing hammer as shown, which is used later.

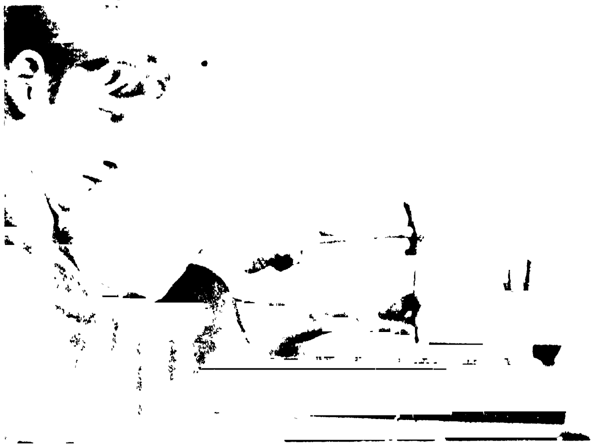
When the required depth is obtained, attention should be given to planishing the surface to remove all bruises. The illustrations (*right and left*) show the method of holding the plate against the edge of the bench or a block of wood fixed in the vice, using the blocking or hollowing hammer for trueing the hollow part and the flat-faced steel planishing hammer for the rim.

Large hard-wood punches may be used as a substitute for small work on a soft pitch block, finishing the surface with brass raising tools. Now anneal the metal,

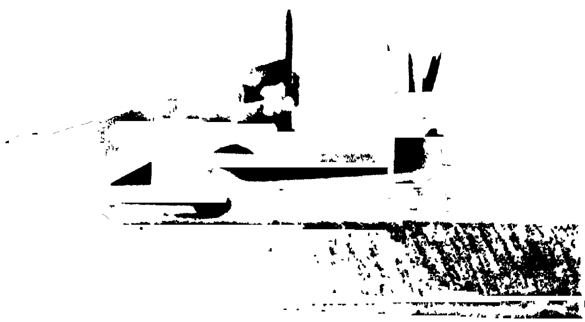
PLATE XXXI



WARMING THE PITCH BLOCK



POSITION OF HANDS AND TOOLS WHEN TRACING



METHOD OF HOLDING THE TRACER

RAISING ON SANDBAG, AND CRIMPING

BOSSING ON SANDBAG, AND SHAPING

HOLLOWING, PLANISHING AND SOLDERING

When the rim has been decorated and the metal finally cleaned, the edge may be either wired by beating up a bead with a steel raising tool, laying the wire in the hollow and hammering over the edge; or by resting the edge upon a strip of brass or iron with a V-shaped notch filed on the end, and with a raising tool, hammering the metal down into the notch at suitable intervals around the edge of the plate (see Plate XXXIII.).

Ink Stand.—No. 10 gauge copper may be used for this article, which gives an opportunity for more advanced modelling, and in addition to bringing into use a greater variety of raising tools on the back, the relief may be further enriched by working over the front with planishing tools, to correct or emphasise the modelling or to give a variety of texture.

Proceed with the modelling by easy stages and do not attempt to get the full relief all at once nor all the detail. Remember to anneal the metal if necessary, as it becomes hard and liable to crack when hammered and stretched. Cut the diagonals of the inner square with a chisel, file the edges and bend to a right angle, giving the corners a slight scroll with a pair of pliers. Solder a piece of metal underneath to hold the ink-pot, or fix to wood base (see Plate XXXIV.).

Pipe Rack.—The large plain masses are slightly domed upon the sand-bag, with the bossing mallet and wooden punches, after the tracing and raising are finished Then, filling in the sunken parts on the back with broken pieces of pitch, the metal is held over a bunsen flame with a pair of pliers until the pitch melts and flows into and fills up all the hollows level. When this has set, it is warmed and pressed firmly down upon a warm pitch block, and when cold the work is ready to be finished on the front.

Now go carefully over the outline with a thick blunt tracer, and wherever the background has been lifted above the level by the hammering on the back, this is corrected with the tracer, bringing the background to its original level. Instead of holding the tool upright as before, we now lean it over sideways so that the flat of the tool rests upon the background, the object being to force the metal at the edge of the relief portions underneath the outline, thus giving a crisp finish The tool must travel along continuously as in ordinary tracing.

There being no longer any need for the original traced outline, which served as a guide for raising on the back, we now smooth away the marks left by the tracers, using for this purpose a planisher.

Any bruises left by the raising tools are now smoothed out, the tool being moved along the direction of growth, thus bringing the various bosses and hollows of the relief into more perfect harmony without getting it harsh.

The holes for the pipes can either be punched out with a circular punch on a block of lead, or cut out with a piercing saw. The projecting shelf is riveted to the back. If made in copper it may now be bronzed, after thoroughly cleaning, by immersing in a hot solution of ammonium sulphide and water, the proportion varying with the depth of colour required. Rinse with water, dry out in sawdust, and polish with a soft cloth or leather (see Plate XXXIV.).

Equipment.—A good solid bench is, of course, best, but ordinary school desks and tables will do. A separate bench for general use will be necessary, the top of which should be covered with sheet iron on which the stove and kettle for boiling the pitch may be kept, also a short length of flexible tube attached to a piece of iron pipe fixed to the side, with tap to supply the gas flame for warming the pitch and cleaning the metal (see Plate XXXI.).

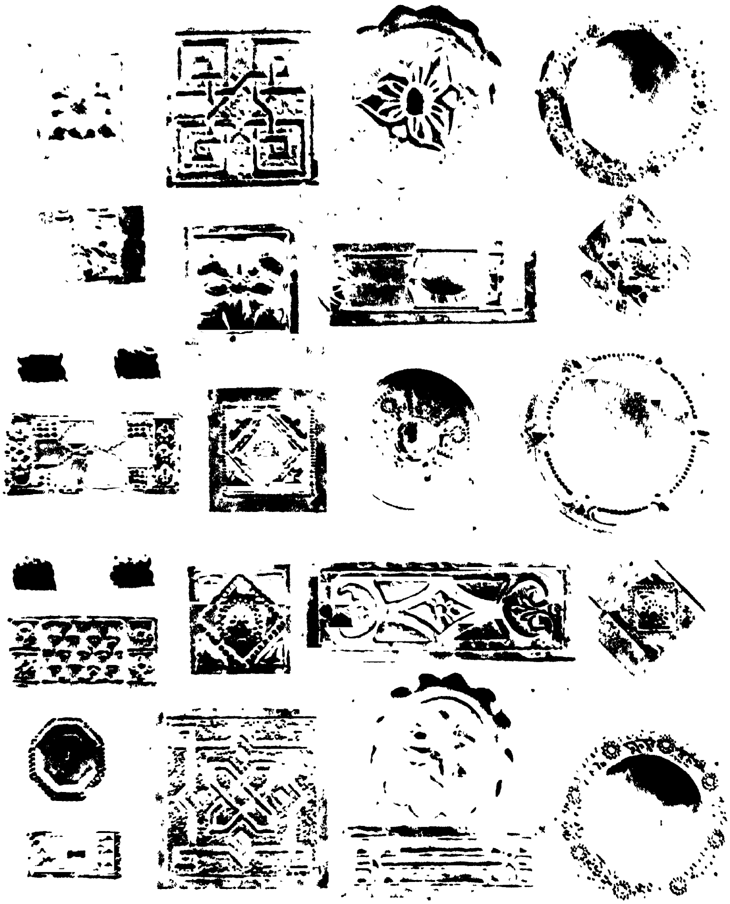
This bench or table will also be used for all the processes of attaching the metal to the pitch, removing, and cleaning up. It may be made long enough to accommodate a soldering stove, a leg vice, a hard-wood block, lead block, sand bag, etc.

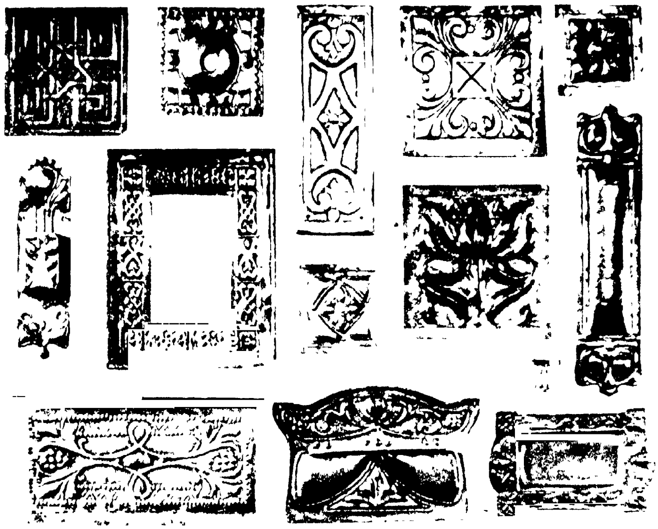
Stools will be required if ordinary benches are used.

On the wall behind, racks may be arranged to hold shears, hammers, pliers, files, mallets, and other special tools, and underneath the bench shelves might be fitted to store up the pitch blocks. A box or cupboard will be required for storing the smaller tools, metal, drawing materials, and finished work.

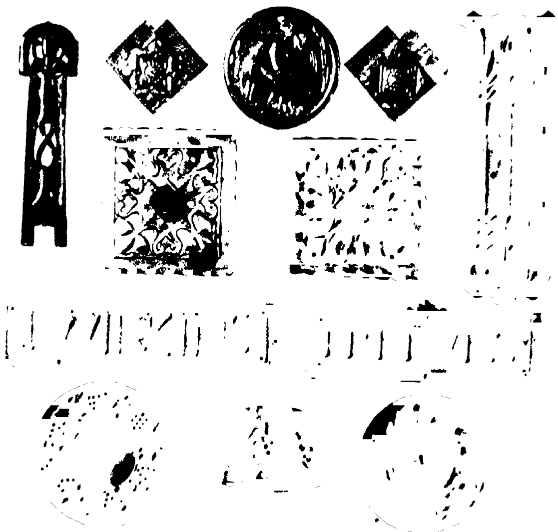
To lessen the sound caused by hammering, a canvas bag filled with fine silver sand may be used under each pitch block, and a leather bag about 8 in. diameter, also filled with sand, will be needed for resting the metal upon when bossing up with the mallet.

The hard-wood block should be about 12 in. square, by 3





EXAMPLES OF STUDENTS' WORK INTERMEDIATE COURSE



EXAMPLES OF STUDENTS' WORK ADVANCED COURSE

or 4 in. thick, and, as it will be used for flattening purposes, the surface should be planed up.

Lighting.—It is important that the work should be done in a good light, which should come from the right-hand side, for if shadows fall across the work in front of the tool, it will be extremely difficult to follow the outlines of the drawing. If artificial light is used, a movable bracket will be necessary, and should be provided with a shade.

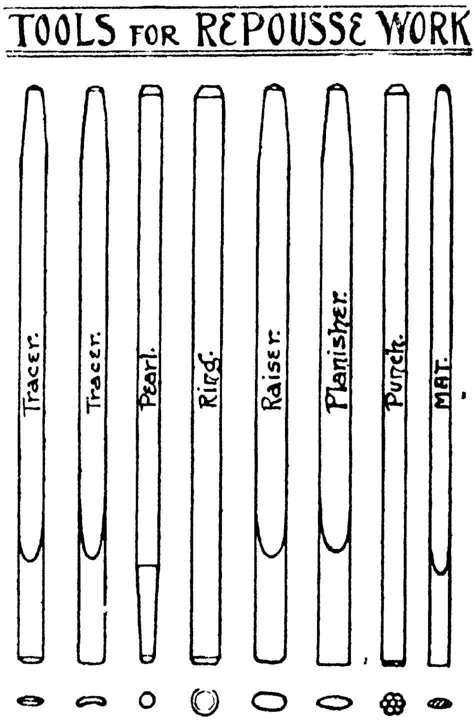
Tools, Appliances and Materials.—Repoussé hammers, head about 4 oz. being most suitable weight for general use, with long thin lancewood handle having a pear-shaped end to afford a more comfortable grip (see Plate XXXI.).

One for each pupil will be required.

One ordinary carpenter's hammer, "Warrington" pattern, used in making up, riveting, etc.

One bossing mallet, used for bossing and flattening on the sand-bag and hard-wood block. The head is of boxwood, the faces being slightly rounded and the handle made of lancewood of a similar shape to the repoussé hammer handle. An ordinary plumber's bossing mallet (see Plate XXXII.) will answer for hollowing, but a flat-ended mallet will also be required for straightening out.

A few sets of chaser's tools, with one set of special tools in steel, brass, and wood. The



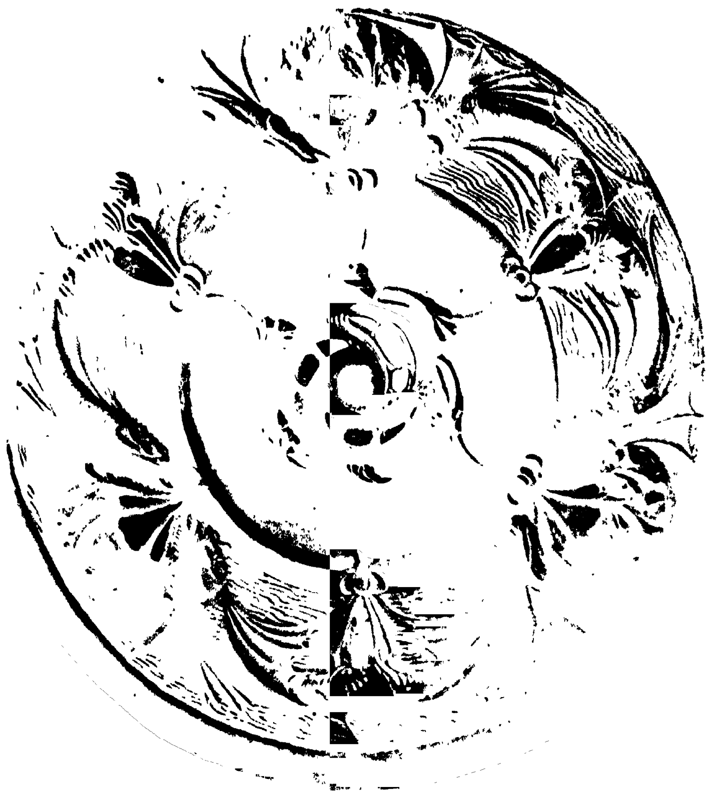
steel tools may be made from $\frac{1}{4}$ in. and $\frac{3}{16}$ in. round and square cast tool steel, filed to shape, polished with emery cloth, and tempered. The brass tools are made from $\frac{7}{16}$ in. brass rod and the wood punches from box-wood.

The chaser's tools should be a selection of the following varieties:—Tracers, straight and curved, three sizes; raising tools (steel), assorted sizes and shapes; raising tools (brass), one set; raising tools (boxwood or lignum vitæ) one set; ring, pearl, matting, and grounding tools, assorted sizes, one set; scribing point, used in scratching in the outlines on metal; steel rule, 12 in., English and Metric; wing compasses, 8 in., and spring dividers, 4 in.; try squares, 6 in.; pliers, 6 in., flat and round-nosed; shears, 8 in., straight; files, $3\frac{1}{2}$ in. and 6 in., flat, half-round, etc.; saw frames and piercing saw blades; Archimedian drill and bits; tinman's stake for shaping up the work, planishing, etc.; pair of smith's flat tongs, a cold chisel, leg vice, soldering iron and stove.

Blow-pipe, bellows, and gas connections, or flexible tube and large bunsen burner. Iron tray with breeze for annealing the metal upon. Pitch kettle (gipsy pattern or an old saucepan) and ladle (see Plate XXXI.). Gas-ring for warming the pitch. Small lead vat or pitch-lined wood box for the sulphuric acid for cleaning after annealing. Lead blocks about 4 in. × 5 in. × $\frac{3}{4}$ in. Small blocks of birch wood about 4 in. × 3 in. × 2 in. for turning up the edges of trays, etc. Length of iron pipe, about 12 in. long × $1\frac{1}{4}$ in. in diameter for working up cylindrical shapes. Pitch blocks made of red deal about 12 in. × 10 in. × 3 in. thick, to the edge of which thin strips of wood ($1\frac{1}{4}$ in. × $\frac{3}{8}$ in.) may be nailed (see Plate XXXI).

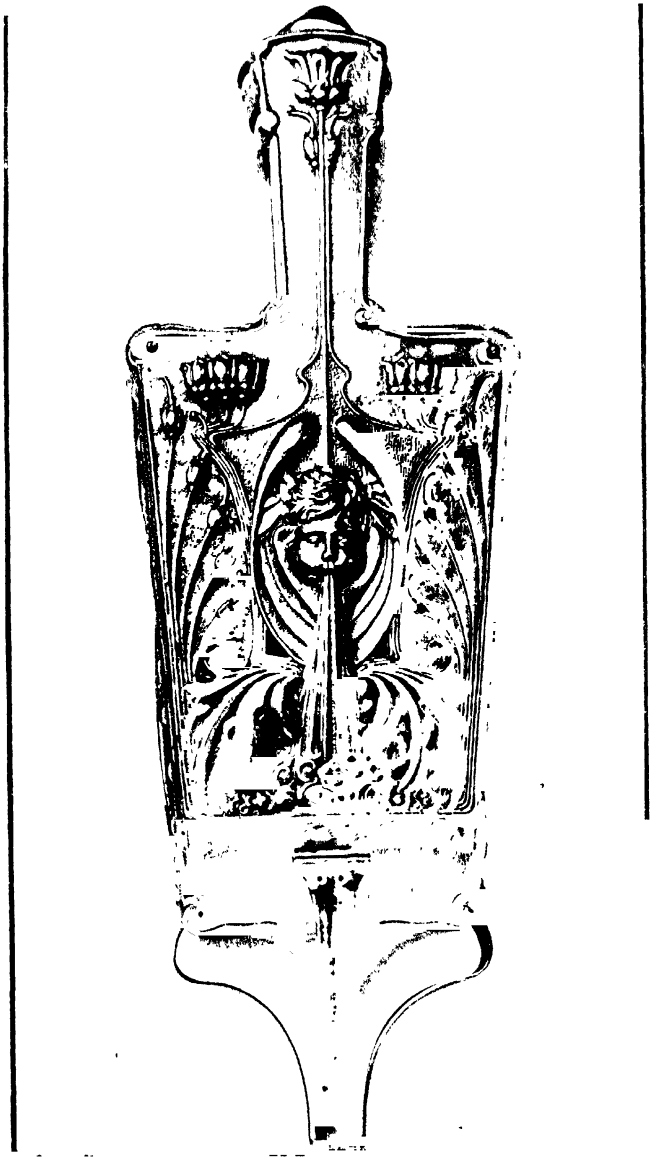
Brass and copper Nos. 5, 8, and 10 metal gauge, soft rolled. This may be procured specially prepared for repoussé work, which saves the trouble of annealing and cleaning previous to working and also gives a better finished surface.

The ordinary copper may be prepared by heating to a red heat and quenching in a solution of sulphuric acid and water, which removes the oxide; the work is then scoured with powdered pumice, using a hard brush and water, afterwards swilled with clean water and dried in sawdust. This process is repeated whenever the metal becomes hard and springy through hammering.



PLAQUE IN REPOUSSÉ COPPER AND ENAMELS

Designed and Executed by J. W. Wilkinson



BELLOWS IN REPOUSSÉ COPPER
Designed and Executed by J. W. Wilkinson

The Birmingham Metal Gauge is generally in use for gold and silver and also for copper and brass in the art metal trades, the equivalents to the above sizes in the Standard Wire Gauge are Nos. 26, 24 and 22.

Copper wire $\frac{3}{16}$ in. × $\frac{1}{8}$ in. for handles, thumb bits, etc.

Copper rivets, assorted sizes. Brass wire and pins, sulphuric acid (commercial), used in pitch-lined vat, two parts acid to eight of water. Scrubbing brush, pumice powder, cotton waste, paraffin oil, emery cloth, turpentine. Tinman's solder, spirits of salts and zinc for the flux. Drawing materials, tracing paper, and carbon transfer paper.

Preparing the Pitch Block.—Materials required:—7 lb. of soft pitch, 4 lb. of black resin, $\frac{1}{4}$ lb. of tallow and 6 lb. of powdered bath brick. White sand or coarse plaster of paris may be used in place of the bath brick if desired. Break up the pitch and melt in pitch kettle over slow fire, add the resin and tallow, and when all are melted together, gradually add the powdered bath brick, constantly stirring with the iron ladle which is also used for "spooning out."

Care must be taken not to allow the mixture to come to a boil, as it would quickly run over and catch fire. Pour out into the pitch blocks to a depth of about one inch and allow to cool before using. An iron spatula is useful for levelling the surface of the pitch block, it should be warmed and pressed into the pitch; care should always be taken to see that no lumps or hollows are left, otherwise they will cause defects.

The illustration on Plate XXXI. shows a bench equipped with stove, pitch kettle, iron-covered top and sheet iron on wall behind the pilot light; the boy is using the pipe mentioned elsewhere, which gives a spreading gas flame for warming the pitch block.

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XXXIX. PAPER AND CARDBOARD MODELLING FOR JUNIORS

By JAMES BOORMAN

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The Need for Continuity between Infant and Junior Work.—Careful gradation of work is essential for the child's natural development. There should be no need to say that the child just entered into the Juniors' classes is the same being as the one who has just left the Infants' classes, and has not vitally changed his nature in making the transition; yet schemes of work frequently overlook this fact. The teacher of handwork in the Juniors' classes needs not only special knowledge and ability in handwork herself, but also a sympathetic understanding of the work that has been done in the Infants' classes.

The same underlying principles apply to the work in both stages. The child needs self-expression, and therefore plenty of "free" work should be allowed. The child should think, plan, and invent for himself, or herself, and not merely work up models of another's conception and design. At the Juniors' stage the object to be made is still the main consideration to the child, but at the same time he will gradually develop a greater interest in the technique—a greater desire for well-made models—and as he is at the same time developing in power to concentrate, the

work may gradually be spread over a longer period, and better work may be expected.

The objects to be reproduced must still be chosen in accordance with the child's interests, and it will be noticed that here again the change is very gradual. The interests of a child of six and of one of ten are widely different, but between the interests of seven-year-old and eight-year-old children there is little difference. Schemes of work must be adapted to this gradual change.

Choice of Work.—The child under ten has not yet arrived at the stage when he will be interested in doing good work for its own sake. The "good work" is only incidental to the main purpose of producing the given objects, and the objects such a child desires to make will be toys which will give pleasure to himself and others, objects useful to himself or to give away as presents, and illustrations of other lessons. Paper modelling may be used very largely for the latter purpose.

The lessons of the day, either in geography, history, literature, or arithmetic, will often furnish scope for illustration by means of paper models; where this is not the case the children should make models of the type suggested—toys or "usable" objects. It is a mistake at this stage to ask children to make an object which cannot be used for some definite purpose; for instance, a model set of furniture may be used to furnish a doll's house, or to illustrate some lesson or other; but such a thing as the "knife-box," which figures in so many schemes of paper work, cannot well be made small enough to fit in with such furniture, while, if made large enough to hold even small knives, it is not strong enough to be practically useful.

The following are suggestions for a few useful articles which can suitably be made in paper: Envelopes of various sizes for various purposes—*e.g.* large envelopes for holding paper-modelling materials, envelopes to contain children's bank-books, etc; Christmas cards (measured, for painting), and envelopes to fit; note-paper and envelopes to fit, for school letter-writing; note-books—pages for notes and coloured cover to fit—useful for containing lists of words, homework, children's out-of-school observations, nature notes, etc.; paper bags for different purposes—carrying lunch, holding gardening seeds, etc.; boxes for holding

counters, shells, other apparatus for number lessons, crayons, pins, nature specimens, etc.; pin-trays and tidies of different kinds, card-cases, book covers, portfolios, etc.; toys, such as kites, windmills, lanterns, trains, etc., as suggested in the Infants' section, but of more difficult construction; pocket-comb cases, needlebooks, cases for shaving paper; frames for picture postcards, and books to contain cards illustrating history, geography, and other subjects.

Procedure in Teaching, and Grading.—The work will at first be exactly similar to that done in the Infants' classes. The same kind of paper will be supplied, and the new teacher should at first leave the children to work on in their own way, making the models for themselves according to the folding methods of the Infants' classes. She will thus get to know the children's capabilities, while they themselves will feel "at home" with the work, and not think that the handwork of the new department is an entirely different thing from what they have done previously.

The first advance on Infant school work will be in *the introduction of the use of the rule.* The paper-modelling lesson alone need not be responsible for this. Indeed, at this stage it is, and rightly too, often difficult to say whether certain lessons should be called "arithmetic" or "handwork." The child will already have experienced the need for some form of measurement. When papering and fitting carpets, mats, blinds, etc., for the Infant school doll's house he had to be careful to make these the right size; hence measurement was needed. Probably a piece of string or of stick was used at first; but this prepared for more careful work.

A good introduction to the idea of a unit measurement would be to let the children divide an 8-inch strip of paper into eight equal parts by folding. This scale can then be used for measuring various objects around, such as books, desks, blackboards, etc., and in the number lesson shopping games may be played, various lengths of materials being bought and sold. These strips may be compared with the ordinary 12-inch rule, and the children may then make themselves rules in thin cardboard, marking only the inches.

If the teacher prefers proper rules, she should endeavour to

get them without the superfluous bit at each end, as this is very confusing to children just learning to use the rule.

1. The first occasion for using a rule in connection with paper-modelling may arise while the children are still doing folded models. Instead of children receiving a square or oblong piece of paper of the required size, they may be asked to cut it from a larger sheet.

2. This almost immediately leads to *the difficulty of obtaining right angles*. Paper is cheap, and children should be allowed to *experience* this difficulty. Their "squares" will in many cases be obviously faulty, and a little comparison with a "real" square will show that the angles are either too small or too large. The folding method of producing a square may be used; but the fold along the diagonal will sometimes be undesirable, and in any case an oblong cannot well be obtained in this manner.

The children may be allowed to suggest means of getting the corners right, and such primitive means as drawing round the corner of a book, or a square tablet of the kindergarten gifts, or the cubes of Gift III, may be used before the set square is introduced to the children. Having experienced the need of the square, the children will be ready to receive it, and will better understand how to use it.

Good practice in the use of rule and set-square can be given by letting the children measure, and cut out to exact size, flat paper representations of objects such as books, blackboards, pictures, etc. Measurement should deal at first with whole inches, half and quarter inches being introduced later, when the need arises, and when children are more proficient in measuring.

Simple objects such as note-books, pocket-books, etc., may now be made to given sizes. Objects requiring more "making up" should at first be treated as in the Infants' classes. In some cases the children will experiment and try to produce the object for themselves. At other times a finished model temporarily made up by the teacher, or by an older class, will be taken to pieces, and measured by the children, who will then reproduce the measurements on their own papers, afterwards cutting and making up.

3. A further advance in construction will be *the use of flaps*

in making the joints at the corners. The children may be led to discover this, and also how *to work up a model from investigation of a finished model—effected without unfastening it*—in the following way. Let them make a small box similar to the one made by folding from the sixteen-square ground form in the Infants' classes (see Figs. 4, 5, and 6). The box may be needed for some school purpose such as holding counters, seeds, crayons, etc., and the teacher will suggest dispensing with unnecessary folds.

The size of the box having been decided on (say, a 2-in. square base, and sides 1 in. deep), the children, with the teacher, will proceed to discuss the size of the paper required. Beginning from the base, obtain first the length of the paper, that is, 2 in for the base added to 1 in. for each of the two sides, making 4 in. and next the width, that is 2 in. added to twice 1 in., giving 4 in once more. Therefore a 4-in. square of paper will be required.

The 1-in. sides will now be measured and drawn. This leaves at each corner a 1-in. square, apparently not needed. One child may be allowed to cut these out and show the result: there is nothing with which to fasten the box together at the corners. Suggestions may now be made by the children, and the paper compared with that used to make the same box by the folding method. They are similar except that in the latter nothing was cut away. This plan, however, makes the sides too thick so the children will probably now suggest leaving only a "flap" to fasten the edges together. The position for these flaps can be worked out on the drawing. They need not be measured at first. The children should be allowed to judge the necessary width.

After working up a few models in this way, the children will be able to tackle new objects of simple construction for themselves. The drawings should be worked out on the paper, or on other paper before cutting. More complex models should be taken to pieces to examine their construction; and much work should be done from the children's own ideas and planning.

4. *Simple working to scale* may be taken by letting children make large objects a half, a quarter, a tenth, etc., of the real size or by letting an inch represent a foot, a yard, etc., always avoiding, at present, measurements involving fractions of the unit other than halves.

5. *Other ways of fixing the models* may be used, such as the use of the slit and flap depicted in the bon-bon box given in the Infants' section (see also Fig. 2), or punching holes to be laced and tied (see Fig. 10). Children of nine years and upwards may cut out $\frac{1}{2}$-in. strips of coloured paper to be pasted and used for fixing two edges together, but this is somewhat tedious work and the method should only be used occasionally.

6. *Thicker paper should gradually be introduced*, and nine-year-old children may have thin cardboard, such, however, as can still be cut with scissors. They will find the folding of this a difficulty, and when the need arises they may be shown the *use of scoring*. This consists of cutting half-way through the board on the *outside* of the fold in order to make accurate folding easier. For the cutting a small-bladed carton knife may be used. The children will need a board, or mill-board, to work on, and a ruler with safety edge to prevent cut fingers.

Throughout the work children may be allowed to decorate models, where suitable, in their own way by drawing, or adding ornaments cut out of paper.

Free Work, Group Work, and Correlation with Other Subjects.—So far the teaching and grading described have dealt chiefly with the technical and formal side of the work. It must not be understood, however, that this is the only, or even the chief, aspect of the work. As in the Infants' classes, much free work should be allowed, and there should be group-work models illustrating history, geography, and literature lessons, as well as single models of objects connected with these subjects. There will be more of these than of the other objects mentioned, and in this work a basis of graded difficulty is superseded by one of interest and suitability, so that the work will be largely informal and prompted by the interest of the day.

The connection between *Paper-modelling and Arithmetic and Geometry* has already been somewhat fully described. The child learns incidentally by experience (the ideal method of learning), and practically, a great deal about number, about measurement of length, and about forms and angles, which, divorced from this practical work, would cost much arduous toil, and be worth much less as knowledge to the child.

The subject of "*area*," that supreme task to the "old Standard IV" teacher, is robbed of its difficulty, for already in Standard II the children know *practically* what it means, and a folded piece of paper quickly demonstrates the difference between "four square inches," and "four inches square." Simple questions as to surface areas may easily be asked occasionally in the course of Standard III work.

Models for use in the arithmetic lesson can also be made in paper. For example a set of measures of capacity may be very useful. A box made, say, on a 4-in. square base may be made any depth greater than is judged necessary to hold the contents of a standard pint measure. The contents of this measure (bran, sawdust, etc.) will be poured into the model, which will then be cut off to the proper level.

Other measures may then be made double, or half this size as the case may be. These will be useful for the "shopping" number lessons, and it will interest children to note the different weights of the same volume of different materials.

Paper Modelling and Geography.—Very interesting work can be done in making group models to illustrate geography lessons. This supplies a "purpose" for the handwork, and adds interest to the geography, besides being admirable social training for the children. Home geography, and stories dealing with the social side of life in other lands lend themselves equally well to illustrations of this kind.

Group models showing rooms and furniture in the school and the home; models of a town street, a village, the beach at a seaside resort, a country fair or wake, and a farmyard all offer much scope for observation and ingenuity. A model of a shop, such as a furniture shop or general store, is full of possibilities, and would furnish useful and interesting apparatus for the number lesson.

Going farther afield, models of scenes in other lands—such as a Japanese scene showing houses, temples, pagodas, jinrickshas, screens, lanterns, fans, and other objects, suggested as the work develops—are attractive and valuable, in making knowledge more real. Other scenes offer equal scope—*e.g.* a Breton Market Square, an Eastern Market, a Dutch Scene, an Alpine View,

GROUP WORK. A SEA-SIDE SCENE.

[illegible] THE PIED PIPER OF HAMELIN

1. USE OF SCISSORS—BAD POSITION
2. USE OF SCISSORS—GOOD POSITION
3. SCORING WITH CARTON KNIFE
4. CREASING
5. MEASURING FROM RULE
6. PASTING A HINGE

are a few suggestions which an ingenious teacher and class will easily develop.

History and Literature may be illustrated in the same way. In connection with history, old types of buildings, furniture, and appliances, may be reproduced. Many stories will suggest illustrations by means of co-operative paper modelling, and history and geography together will be illustrated by the reproduction of local objects of historic interest, such as village stocks, old buildings, and curios from local museums. Ancient and modern methods of travel would suggest a very interesting course of models.

Poems and stories may be illustrated, and the village street of Hamelin, the house of Hiawatha, the bed-room scene from "Water-Babies" are only a few suggestions. Bible stories, to be made real, also demand some concrete illustrations, and models of the Tabernacle, the Temple, Eastern houses, city walls, tents, tombs, sheepfolds, assist considerably in supplying this need.

In conducting lessons of the above type the methods suggested in the Infants' section should be continued. The suggestions should come from the children. In the case of reproductions of local scenes, their own observations will be the basis of the work. In the case of more remote subjects descriptive accounts will be given by the teacher, together with plentiful illustrations by means of pictures and concrete models where possible.

Children and teacher together will allot the work in the case of group models. In some cases the whole class may make each separate object and only the best will be used; but in other cases it is not necessary for every child to make a given object, so that different children should be working as a rule on different parts of the whole thing.

The children should work independently, planning out their method of work from their own observation, and from pictures and models supplied. The teacher should guard against dictating and prescribing special methods of work. At the same time she herself must be expert; she should never—except by way of pure experiment, and that very seldom—ask the children to make an object with which she has not previously experimented herself. If necessary she can then come to the children's assist-

ance at difficult points and suggest improved methods of work. This must be done with discretion, but when children are really interested they will welcome a little help, and will gradually improve both in ideas, and in work.

Towards the latter part of this period, and, with a few of the more clever children, even earlier, it will be advisable to allow the use of the carton knife and straight-edge in addition to the scissors, already introduced. As, even at this early stage, the cultivation of right methods of using tools must be the aim, it will be well, perhaps, to deal with some of the more simple operations, and the considerations which determine the correct use of certain tools. This may be of advantage to teachers not very familiar with the work. It is not suggested that it is necessary or advisable, always, for a teacher to give the reasons to a child. It is very necessary, however, that the teachers themselves should appreciate their importance, and that they should realise that there are good grounds for adopting certain methods and discarding others.

Measuring.—The first operation essential to good work is accurate measuring. This should be taught quite early, and good methodical habits inculcated. In using an ordinary rule it is absolutely necessary that the eye should be brought right over the mark corresponding to the measurement which is to be made, if the pencil dot indicating position is to be accurately placed. If several measurements are to be made in one line, the addition of the quantities should be made mentally, and all the positions marked before the rule is moved from the initial position.

Use of Scissors.—The proper handling of scissors may well be considered next. It is quite astonishing how few teachers have even considered whether there is not a way of holding and using scissors better than any other, and calculated to secure the best results, and why the result should be so much better in some cases than in others. In the first place, as a general rule, the right elbow should be pressed somewhat firmly against the side of the body, and the hand should remain in one position, with the blades of the scissors in a vertical plane, always pointing directly away from the body, while the work is moved to the scissors, not the scissors to the work. The eye should be in the same plane as the

scissor blades, so that the person making the cut can see if the cutting edges are keeping in the same position relative to the line. This cannot be done if the scissor blades are sometimes working in one plane and at other times at some angle with it. Again, it should be remembered that, as the fingers exert their power always at the same distance from the fulcrum, which is in this case the rivet, the force applied to the paper will vary inversely as the distance from the fulcrum, of the place of actual cutting. Thus the operation is much easier if the material is brought well into the angle between the blades, and these are well open (see Plate XXXVIII.). More complete control, as a consequence of more economical expenditure of power, is a further result.

Creasing.—The next process to know is that of creasing. This consists in compressing the material along a line to reduce the thickness, thus making bending an easier matter to accomplish with certainty and precision. The operation is performed with a bone folder moved along the edge of a rule or straight-edge adjusted to position, as in drawing a line with a pencil (see Fig. 4). The edge of the folder must be sharp, and quite smooth and polished. Any roughness will tend to tear the material, while it is only intended to compress it, forming a narrow groove. After two or three strokes, the folder is placed under the paper, on which pressure is still maintained by the rule, and the paper is pressed up against the firmly held rule (Fig. 27, Pl. XXIII., p. 190, Vol. 1). The rule may then be removed, and the paper folded right over and rubbed flat. This method will give a decided crease, without risk of cracking or breaking, even with material as stout as thin carton.

Pasting a Flange.—Another operation is that of pasting a flange. As soon as any pasting or gluing is to be done, the need of waste paper under the model to prevent adhesive reaching the desk or table will become apparent. Old newspapers will be found most useful for this. They can usually be had in plenty, and can be folded up, and put away, as soon as the surface becomes sticky. Even apart from this, it is an excellent plan always to work with the table covered with paper. It keeps the model, as well as the table, much cleaner. If a flange is to be pasted, the model should be laid on clean paper and covered with newspaper,

leaving only the part to be pasted exposed to view. The paper may now be held down by the fingers, and the paste rubbed well into the flange. This rubbing is quite necessary if a good joint is to be made. Mere laying on will not serve well. A film of air will often cover the flange surface to such a degree that, if not rubbed, the flange will curl away from the paste, and not adhere at all. After pasting, the flange should be folded over into position, and held down for some minutes, either by putting the model under a drawing-board or a cutting-board, or by holding with the fingers or by clips. Clips and fingers are more satisfactory in holding a paper or carton flange if supplemented by two pieces of card to distribute the pressure. The reason for this is easily followed when it is remembered that damping a piece of paper or card will cause it to expand, and when notice is taken of the fact that one side of the paper has been damped by the paste, while the other has not.

The brush used should not be large or soft. One of the size usually supplied with gloy bottles, and of the same degree of stiffness is suitable. A flat brush, however, is more handy than a round one, as it permits a narrow strip of paste to be laid by turning the brush edgewise.

Cutting with the Knife and Straight-edge.—The next operation may be that of cutting with a knife and straight-edge. The knife to be used with carton by little children should be either one of the several carton knives sold at less than a penny, and consisting of a small blade in a round handle, or the "Bevis" safety knife. In either case the blade should not be allowed to project from the handle more than a quarter of an inch. This will do much to prevent the children cutting themselves, and even if they do cut themselves the cut can hardly be a very serious matter. These knives should, however, be inspected by the teacher before giving them out, in order to see that the blade projects the proper distance, and is quite firm in the handle. For older children the "London" or "Leipsic" pattern, with a finger guard, is suitable, but the guard is usually placed too far from the point, and thus much power in cutting is lost,—a serious consideration with weak fingers. The presence of the guard is a reminder to children that the cutting edge is on the opposite side, and they are thus less likely to try

to cut with the back of the knife, and press their fingers on the cutting edge. This mishap is quite likely to occur when children are intent on their work. In fact, the more intent they are, the more frequently it seems to happen. For more advanced work, however, the projection of the guard is decidedly an obstruction. It entirely prevents bevelling and splicing being done with the knife. In actual practice no better tool can be used than an old cheese-knife ground down to the required shape.

The straight-edge should be of metal, and for children should have a rib, or a groove, to protect the fingers from being cut, should the knife catch in the edge and run up on to the top.

The several forms of safety straight-edges all have their advantages and disadvantages. The "Non-slip" safety straight-edge is cheap, grips the paper well at the edge, and is light in weight. Also a number will pack into a small space. It is divided on the edges, for measuring, and has an upright as well as a sloping edge. The steel, however, from which it is made, is not hard enough to resist wear for long, and the cuts that give the marks for measuring detract somewhat from the truth of the edge. Those of cast iron are heavy, and, unless accurately planed on the face and edge, do not grip the paper so well. They easily break, if dropped, but otherwise wear well. Pieces of steel about 2 in by $\frac{3}{16}$ in. with a true square edge, and a fence or guard screwed on the top are undoubtedly the most effective rules for accurate work, but are heavy and costly. A piece of hard wood about 2 in. wide and $\frac{1}{4}$ in thick will serve at a pinch, but children will almost certainly cut their fingers through the knife cutting into the edge of the rule, and running up the slope.

Cutting Slabs.—The materials used for cutting on are various. Probably, that which secures the finest finish is a piece of plate-glass. This is out of the question for ordinary children. A piece of lime-wood about 15 in. long, 9 in wide, and 1 in. thick, planed to a true surface, probably comes next. Other suitable woods are kauri pine, birch, beech,—in fact, any hard wood of even texture, and without strong grain to bias the direction of the knife. Zinc plates are often used, but the surface cuts up rough, and the knife needs frequent sharpening. Hard mill-boards are good, and, if carefully used, will last for some time. The softer

boards, however, are almost useless, as they are easily cut deeply, and pieces come out from between the cuts, leaving a very uneven and useless surface.

Half Cutting or Scoring.—Half cutting or scoring is the process of making a cut only half-way through the material. It requires some care, a sharp knife, and a little practice and judgment. An important difference between this and creasing must be noticed. In creasing for a fold, the material is folded *towards* that side on which the crease is made; while in scoring, the folding must be *away* from the cut side. Comparison with a door, or with a pair of thick cards joined by a piece of cloth on one side to form a tight joint, will be a good way of showing the reason for this, and, once clearly understood, mistakes will not be frequent. This half cutting is a method of making a corner of a box or tray in thin card or carton, and it reduces the strength of the material by one-half. If strength is required, it can be obtained by binding with cloth strips, after bending to the form required. The method can be used, in forming flanges for joining, when the material is thin and the flange can be hidden, or will not be too unsightly. In some cases an advantage is obtained by splitting the flange, and removing a layer equal in thickness to the depth of the cut, but in every such case the flange should be bent to its ultimate position before splitting, as otherwise a difficulty may be experienced in getting it to bend at the precise position required.

Some Models.—*Serviette Ring in Stiff Paper* (Figs. 1 and 2).—This provides an easy exercise in measuring. The fixing is done by means of a slit and flanges. The size of paper required is 8 in. by 2 in. To cut the slit and flanges fold the top and bottom edges lightly together without creasing, and cut, judging the

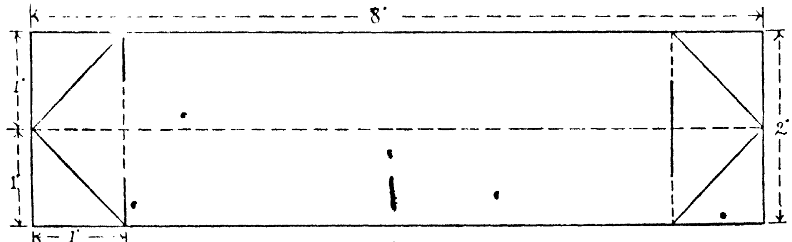


Fig 1.

distance, at one end half-way across from the folded edge, at the other end half-way across from the loose edges. To fasten, turn the flanges over towards the centre without creasing, insert in the slit at the opposite end, and open out (Fig. 2).

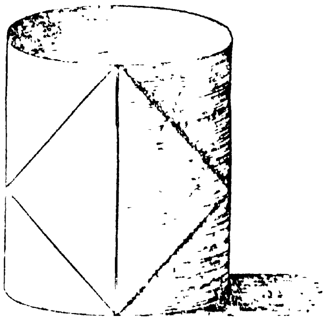


Fig 2.

A Seat (Fig. 3).—This model should be made of such a size that it may be associated with other objects of a like kind. It introduces the method of fastening by means of paper-fasteners. Number "O" size will be found suitable. A hole should be made first, and the fastener inserted. Then the model should be stood

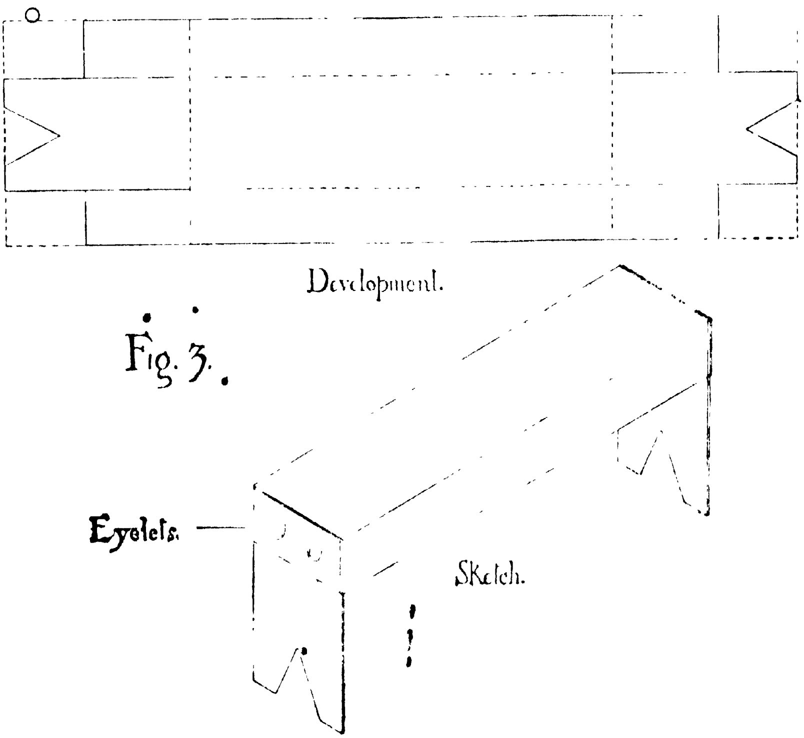


Fig. 3.

up on end, and the fastener spread and pressed out flat, either with the bone folder, or the point of the scissors.

Box or Tray (Figs. 4, 5, 6) with 2-in. square base and 1-in. deep sides, made by folding method, or by a more advanced method. In Fig: 5 the depth of the sides is obtained by dividing the whole sheet into four parts each way by folding. The whole of the paper is used. By the method shown by Fig. 6 the base is drawn out first. Then sides 1 in. deep are added, and lastly flaps for joining the edges together. They can at first be "judged" until children are proficient in measuring. The shaded part is waste. N.B.—In this case the children would not necessarily have a 4-in. square to begin with.

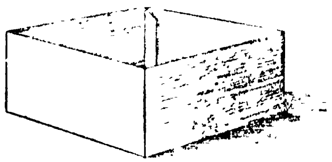


Fig 4.

Fig 5.

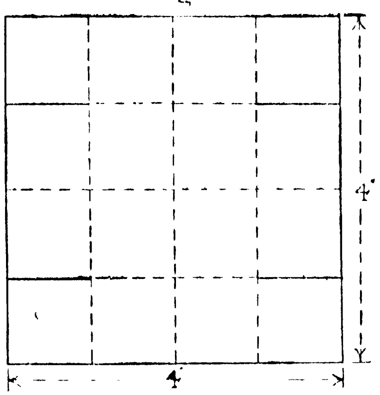
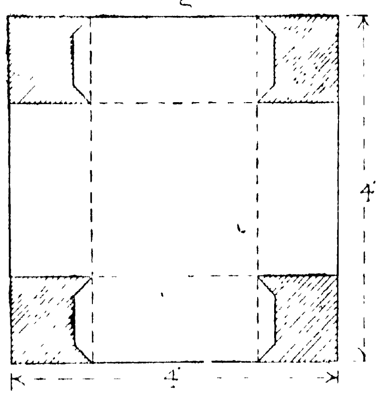


Fig 6



A Lantern for Christmas Decorations (Figs. 7 and 8).—This is a good exercise in measuring of half-inches. The model should be made in brightly coloured paper, and it may be made any size. The one illustrated is cut out of paper 8 in. by 10 in. Down the length of the paper rule lines ½ in. apart. Rule lines across the paper 1½ in. from the top and bottom edges. Fold the top to the bottom, and cut down the vertical lines as far

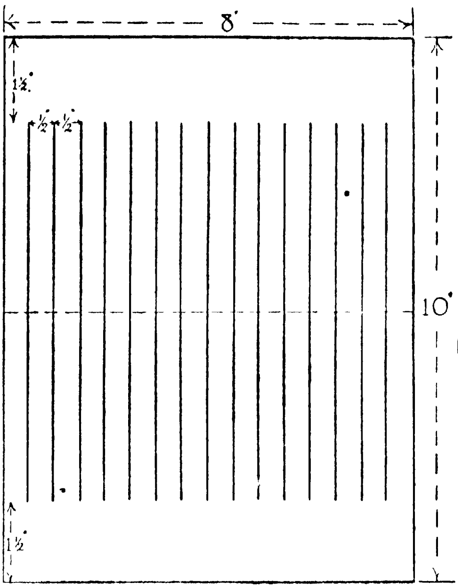


Fig 7.

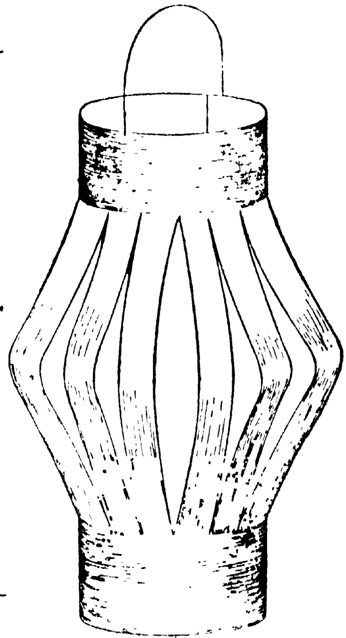


Fig 8.

as the horizontal ones. Open out and paste the two long edges together.

A Tidy (Figs. 9 and 10).—This gives an example of joining by

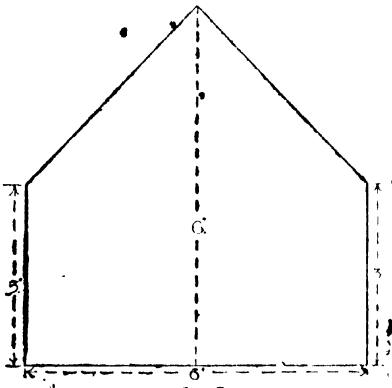


Fig 9.

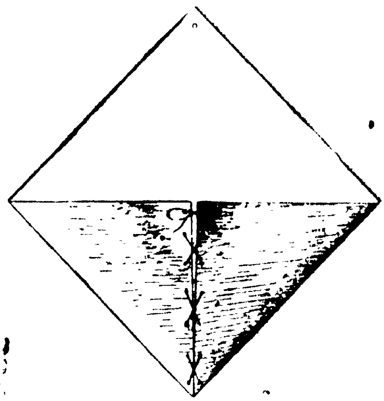


Fig 10.

means of lacing. Draw as in diagram. To make up turn two halves of the bottom line upwards along the middle vertical line. Prick or punch holes and lace with cord, silk, raffia, or ribbon.

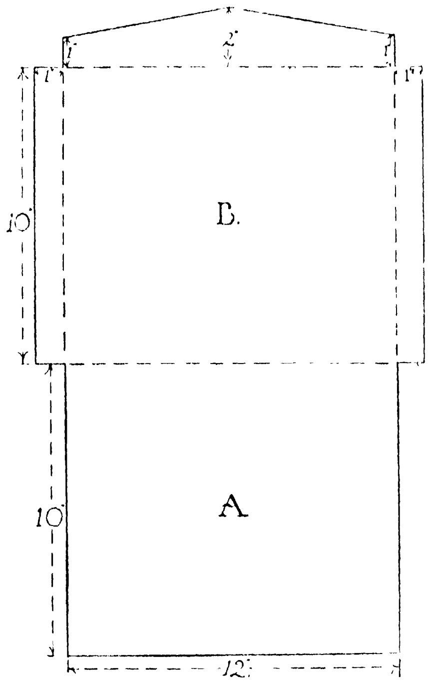
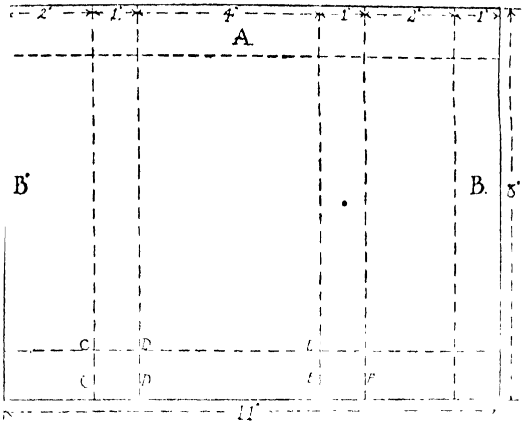


Fig 11.

A Large Envelope (Fig. 11)—made in brown paper—to hold children's paper-modelling apparatus. This is a very simple form which children could easily invent for themselves. Fold up A over B. Turn over the two side flaps. Before fixing, the children may be led to see the advantage of hollowing out the bottom line of A, and of sloping off the top and bottom edges of the two side flaps to make the work less clumsy. The children may now plan out different forms of envelopes, cutting note-paper to fit. These can be used for school letter-writing.

A Bag (Fig. 12) for children's lunch. Measure as in the diagram. Fold along the dotted lines. The whole of the 1-in. strip A is folded back to strengthen the top of the bag for threading the cord. The folding of the base is somewhat difficult. Children may examine an old flour or grocer's bag before doing this. Directions: Fold C backwards on to C′, producing fold as in Fig. 12 (*a*). Fold D backwards on to D′, producing folds as in Fig. 12 (*b*). Proceed in the same way at the other end. If this is thought too difficult, children may cut lines C, D, E, F, and paste enclosed portions under the base of the bag. The whole strip B is pasted over on to B′. Add handles of cord.



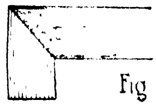


Fig 12(a)

Fig 12(b)

Fig 12.

A Boat or Punt (Fig. 13).—This will give in an interesting manner the use of flanges in a slightly more advanced form. The seats will increase the complexity of the model, and they may be

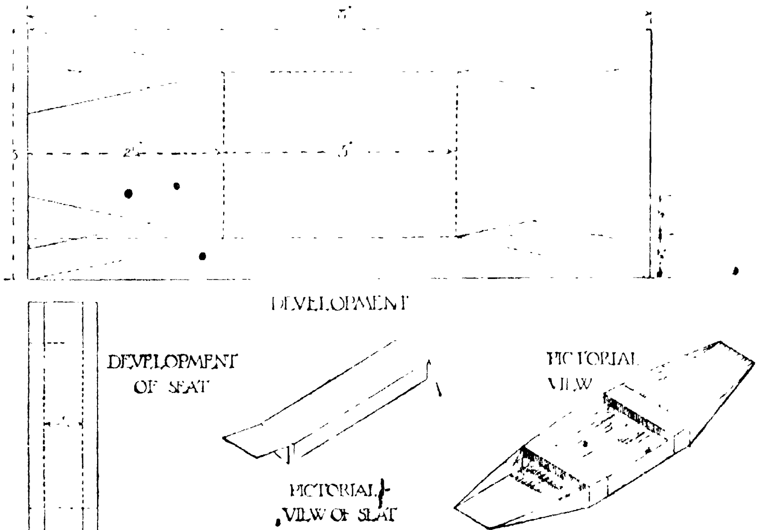


Fig 13

left out without detriment, if it is desired to obtain a more simple example.

A Chair, a Sofa, a Table, and a Bedstead (Figs. 14, 15, 16, 17).—These are examples of furniture for a doll's house. They gradually increase in difficulty of execution and complexity of construction. They will give opportunities for the children to express their ideas as to suitable shapes for the backs, sides, rails, and ends.

Tools Used in the Work.—*The Scissors* are the first tools that come into use for cutting, and are too well known to need illustration. A suitable length is about 4½ in. They should have round points, these being safer for children to use.

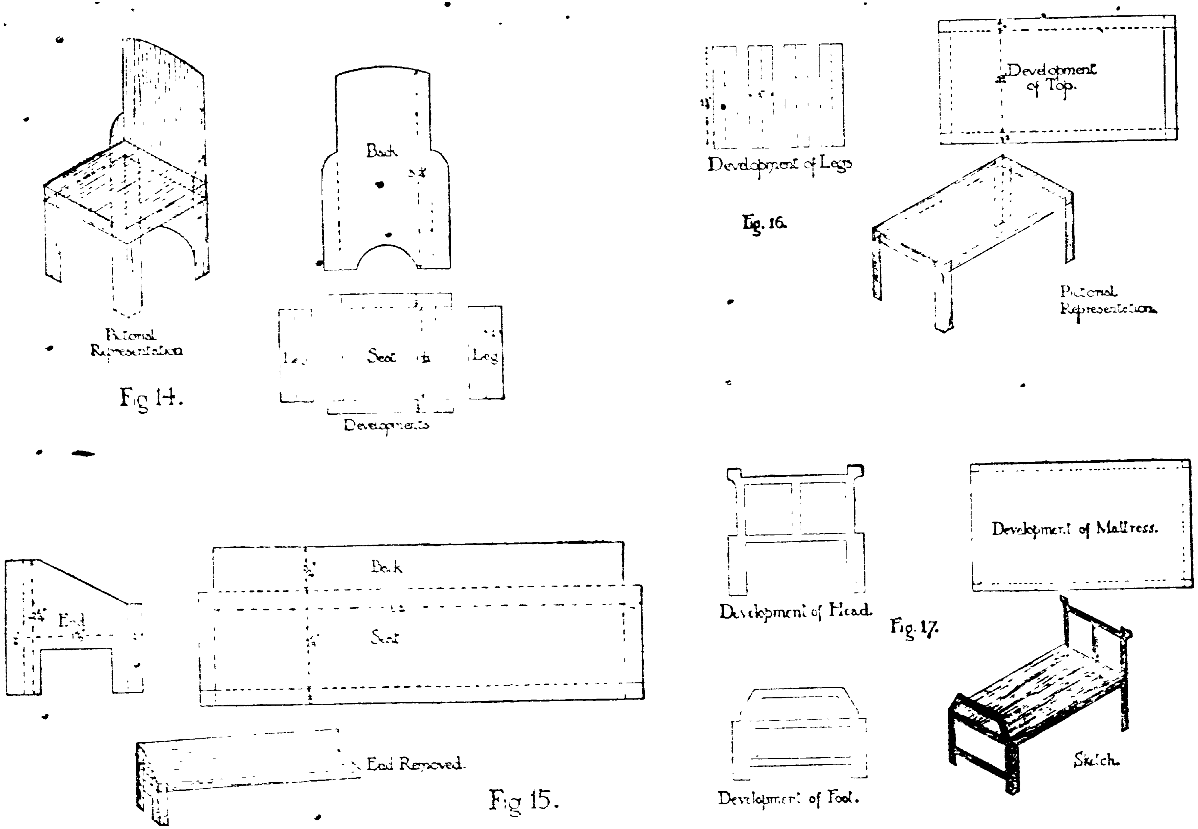
Bone Folders (Figs. 18, 19, 20) may be had in several shapes and sizes. Three of them are shown. The point needs to be quite sharp and *smooth*. It is an advantage to have the other end with a square section. It is then more useful, as it provides a rather larger surface for pressure on a flange or paper edge.

Carton Knives.—Three forms of carton knife are shown (Figs. 21, 22, 23). Each form has advantages, but the simplest is that shown at Fig. 23. The blade is simply a flat piece of steel, sharpened to a lancet point on both sides and both edges. The advantages are that it does not make any difference which side of the blade is placed against the straight-edge, for both are alike and work equally well; while for free cutting the symmetrical form of the point prevents bias in either direction.

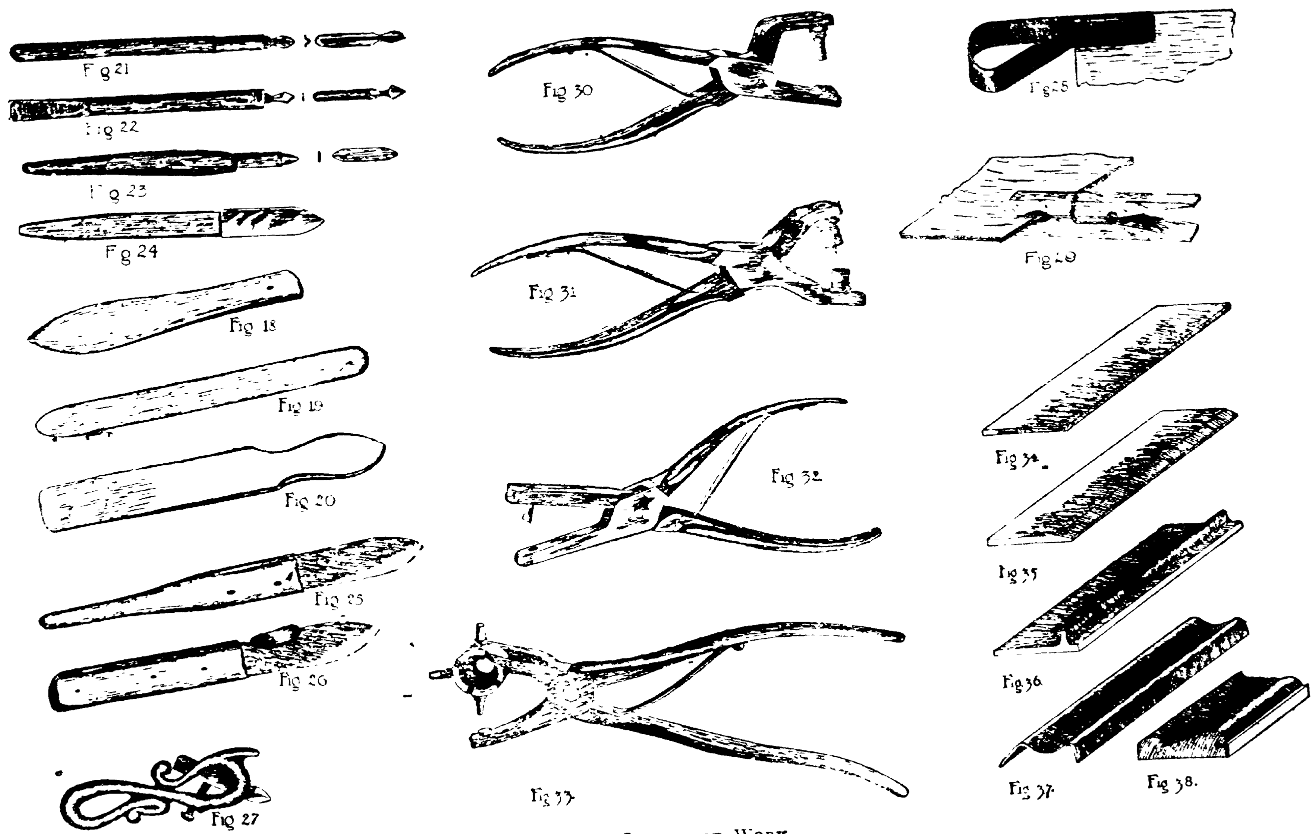
Card Knives.—The first of these shown—the Leipsic knife (Fig. 24)—is simply a flat piece of steel with a piece of wood to form the handle, roughly shaped and riveted to the blade. The next two (Figs. 25 and 26) are English made, the latter of them having the addition of a rest for the finger. The "Bevis" knife (Fig. 27) is intended for young children. It has the advantage of a blade that is adjustable for the purpose of regulating the projection of the point from the handle.

The direction of the blade is known by the feel of the handle, and the finger rest is almost vertically over the cutting point, giving much more power in cutting than when the rest is farther back.

Spring Clips.—It is often convenient to hold flanges of card or carton together for several minutes without movement, to allow the paste or glue to partially set. This is tiring for young fingers,



FURNITURE FOR A DOLL'S HOUSE



TOOLS FOR CARDBOARD WORK

and also causes a loss of time. The two forms of clip (Figs. 28 and 29) shown are both cheap and effective. The former is of metal, while the latter is really a clothes-line peg. It is made of wood with a wire spring. The retail price is from threepence a dozen upwards.

Holing Tools.—Holes of regular form are very frequently desirable in models, for the insertion of cords, or for fastening parts together with eyelets. Plain round saddler's punches are effective and cheap. They can be had in several sizes from $\frac{1}{8}$ in. diameter upwards. A cheap form of punch pliers with one cutter is shown at Fig. 30.

This cutter may be unscrewed, and changed for others of different sizes. An eyeletting tool is illustrated at Fig. 31. It is necessary that the dies screwed to the jaws, and the eyelets used, should correspond as regards size. The die with the point is the one for spreading and flattening the eyelet, while the other forms the rest for the previously prepared side. Another form of punch (Fig. 32) is different in principle. The sloping face of the die gives a "scissor" cut in making the hole. This makes the work easier, and the holes are more cleanly finished. The punch (Fig. 33) has a revolving head which carries four different sizes of cutters. It is handy, but is more costly. It is usually provided with a longer and stronger handle than the other forms, and this gives proportionally greater power in cutting.

Straight-edges.—The flat steel straight edge (Fig. 34), the bevelled straight-edge (Fig. 35), the safety straight-edge of cast iron (Fig. 36), the "Non-slip" safety rule (Fig. 37), and the armoured wood rule (Fig. 38), are those most commonly used in the work. They need no further description here.

BOOKS FOR REFERENCE

M. Swannell, *Paper Modelling* (Philips); E. L. Robinson, *Paper Modelling* (Sisson & Parker); L. L. Plaisted, *Handwork and its Place in Early Education* (Oxford University Press), Ed. J. S. Lay, *The Teacher's Book of Constructive Work* (Macmillan).

XL. TIMBER IN SCHOOL HANDWORK

By John Hudson-Davies

Teacher of Handwork; Lecturer and Instructor to Teachers' Classes, Bucks Education Committee, London, and the Summer School, University College of Wales, Aberystwyth, Examiner to the Board of Examinations for Educational Handwork, and to the Central Welsh Board; Consulting Expert on Trees and Timber to Cassell & Co.'s Publications; Author of "Timber Maps"; Fellow of the Royal Horticultural Society.

Dryness of Timber Essential.—Timber of every kind that is required for use in school handwork should be well seasoned and dry. If the wood is taken direct from a stack in a timber yard, or even from a covered yard shed, it is not fit to be put into immediate use. The fact that it may have been in stock for a long time, and is therefore well seasoned, does not alter matters much; it must also be *dry*. The average dampness of the English climate is such that yard-stored timber—however long it may have been kept—still contains from 10 to 20 per cent. of moisture. Before timber can be regarded as "dry" and fit for use, its moisture-content should be as low as 6 per cent. to 9 per cent. This condition can only be achieved by storing the material in well-protected and dry buildings. The nearer such buildings approximate to the conditions found in an ordinary schoolroom or dwelling-house the more satisfactory and reliable is the timber when put into use. Timber merchants describe such carefully stored timber as being "bone dry."

Timber that is not dry gives much trouble in use. It warps and shrinks, and alters both in form and size. This is a result of loss of moisture. A board that is 12 in. wide when cut from a wet or green log, will, on average, shrink to be less than $11\frac{1}{2}$ in. wide before it has attained the degree of dryness that would make it immune from further shrinkage in an ordinary living-room, in which condition alone it is fit for use in school handwork.

Stages in Seasoning Timber.—Wood that is fresh from a

newly-felled tree contains 25 to 30 per cent. of moisture, the greater part of which, as stated above, must be dried out before the wood can be used with safety. The usual plan is to allow logs to remain for a year in an open yard. They are then sawn into planks. The planks are stacked in loose but orderly arrangement for another year. They are next sawn into boards, as may be required, and the boards are stacked with great care and orderliness, as shown in the photograph. After a few months' storage of this kind they should be moved into a dry building for the final stage of drying. On the other hand, they are frequently sold from stacks in a yard, the buyer being usually aware that the drying process is not complete at that stage (Plate XL.).

A vast amount of board and plank timber is now dried in "timber-drying kilns." The wood is placed in closed rooms through which a current of hot air, from 100° to 200° F., is made to circulate. It is stacked carefully to prevent warping while the quick drying proceeds. In this way it is possible to dry boards 1 in. in thickness, and cut straight from wet logs, in less than three days. Thick planks take longer to dry, and all thick material is liable to crack and split badly under this treatment.

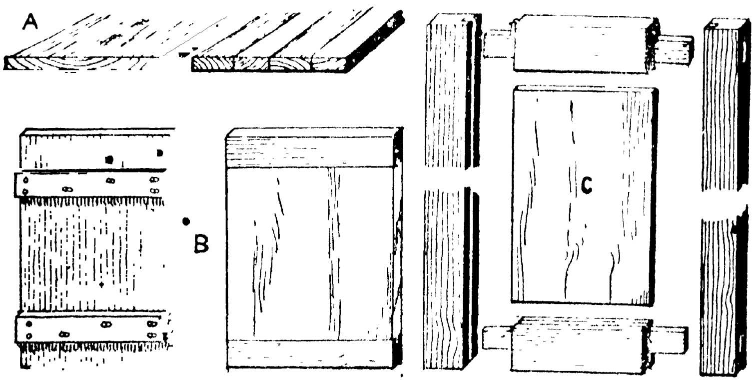


FIG. 1.—COUNTERACTING AND PROVIDING FOR HYGROSCOPICITY IN WOOD.

A. By cutting a wide board into narrow strips and gluing these together again with alternate strips reversed the board is made stable and flat.

B. Methods of attaching cross ledges to secure flatness and to give strength.

C. Showing the grooved framing commonly used in doors, etc. By this arrangement the wide centre panel is allowed some "play" or freedom in responding to the changes in the dryness of the atmosphere.

Counteracting the Hygroscopic Qualities of Wood.—The dryness of wood maintains an intimate relationship to dryness of the atmosphere that surrounds it. However long or thoroughly wood may be dried, it never loses the faculty of taking up moisture, and swelling, when placed in a damp situation; and of giving moisture up to the air, and shrinking, when placed in a drier position. That is why doors, windows, gates, etc., that open and shut freely in the summer-time, become fixed or tight to open in the damp months of winter.

In general, wide pieces of wood must be framed, or cross ledged, as shown in the illustrations, in order to restrain any inclinations to warp, and to provide room for expansion, etc. (see Fig. 1).

One of the incidental values of painting, polishing, and varnishing wood is that, in consequence of the moisture-proof coat that is thus provided, the wood is made more reliable and stable.

Kinds of Wood Suitable for School Handwork.—In the main, the softer timbers alone have qualities that make them generally useful for school handwork. The requisite qualities are: the wood should be easy to plane, bore, and chisel; it should not readily split when nails, etc., are being driven into it; it should admit of being easily attached to itself or to other materials with glue; and it should cause the minimum of trouble in storage and economical utilisation.

Not less than three-fourths of all the wood used in handwork is of the "soft-wood" type. American whitewood, yellow deal, Canadian pine, white deal or spruce, kauri pine, red cypress, and satin walnut are those most in use.

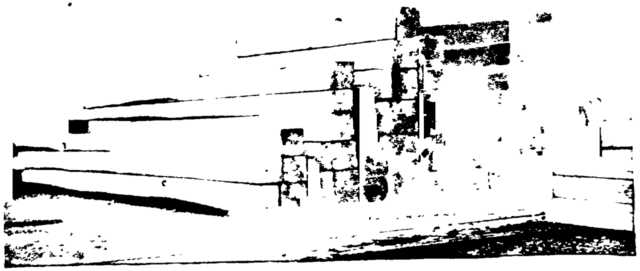
A typical list showing the amount, cost, and character of the wood-material used at an ordinary handicraft woodwork centre is given on the next page. The material shown gives every normal scope in the variety of work that may be taken. It applies to a centre where ten lessons per week are given, each lesson of two and a half hours' duration. Sixteen scholars of twelve and a half years average age attend per lesson. The supply is intended to cover a school year of forty-four weeks.

The Form of Requisition set out below (without the prices) is supplied to timber merchants, with an invitation that an esti-

ENLARGED PHOTOGRAPH OF THE BEETLES WHOSE LARVÆ MAKE WOOD "WORM-EATEN"

(Magnification six times real size)

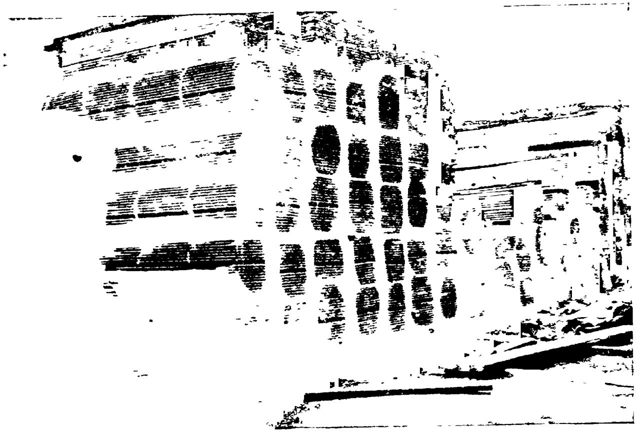
HOW MARAUDERS OF THE FUNGUS TRIBE ENTERED AND SPOILED THE HEART OF AN OAK



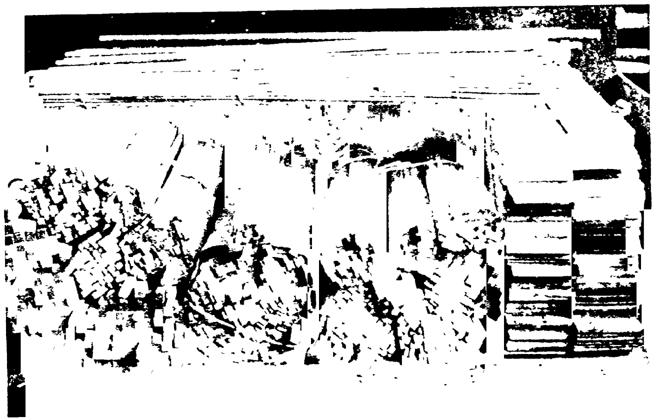
LOGS OF TEAK FROM BURMA, STACKED ON ARRIVAL IN ENGLAND

TWIGS, MOSS, LICHEN, AND VIRGIN CORK FOR RUSTIC WOODWORK

[illegible]



BOARDS AND PLANKS OF TIMBER STACKED FOR SEASONING



MATERIAL FOR LIGHT WOODWORK AND TOY-MAKING

mate for the supply of the amounts of material shown may be forwarded by a stated date.

Copy of Timber Requisition

N.B.—Timber supplied on this requisition must be of the very best quality and bone dry. Boards must be flat, clear of all sapwood on one side, and free from shakes and large knots. The material must be delivered free of charge at (school address), on or before (date).

						Supplied at £	s	d.
American whitewood .	100 ft. super.	1 in. thick,	5d.	ft.,	=	2	1	8
,, ,, .	100 ,, ,,	¾ ,, ,,	4d.	,,		1	13	4
,, ,, .	150 ,, ,,	½ ,, ,,	3d.	,,		1	17	6
,, ,, .	200 ,, ,,	⅜ ,, ,,	2½d.	,,		2	1	8
Satin walnut .	20 ,, ,,	1 ,, ,,	3½d.	,,		0	5	10
,, ,, .	80 ,, ,,	¾ ,, ,,	3d.	,,		1	0	0
,, ,, .	100 ,, ,,	½ ,, ,,	2¾d.	,,		1	2	11
,, ,, .	150 ,, ,,	⅜ ,, ,,	2½d.	,,		1	11	3
Mahogany (Honduras) .	20 ,, ,,	½ ,, ,,	5d.	,,		0	8	4
,, ,, .	10 ,, ,,	⅜ ,, ,,	4d.	,,		0	3	4
Black walnut (Amer.) .	10 ,, ,,	⅜ ,, ,,	3d.	,,		0	2	6
Oak (Austrian) .	8 ,, ,,	½ ,, ,,	6d.	,,		0	4	0
Sycamore ,, .	15 ,, ,,	½ ,, ,,	3d.	,,		0	3	9
Cedar (Mexican) .	10 ,, ,,	⅜ ,, ,,	2d.	,,		0	1	8
Teak (Burma) .	10 ,, ,,	⅜ ,, ,,	4½d.	,,		0	3	9
Padouk (Andaman) .	5 ,, ,,	¾ ,, ,,	4½d.	,,		0	1	10½
Black ebony (Ceylon) .	2 ,, ,,	¼ ,, ,,	6d.	,,		0	1	0
Yellow deal (Baltic) .	200 ,, lineal,	2 × 1 ,,	½d.	,, run		0	8	4
,, ,, .	24 ,, ,,	9 × 1¼ ,,	4d.	,, ,,		0	8	0
,, ,, .	24 ,, ,,	2½ × 2½ ,,	2d.	,, ,,		0	4	0
Canadian yellow pine .	24 ,, ,,	11 × 1 ,,	5d.	,, ,,		0	10	0
Kauri pine (N. Zealand) .	20 ,, super.	½ ,, thick	3d.	,,	=	0	5	0
Total						£14	19	8½

The following notes upon the general qualities of these woods, and the specific purpose to which each is put in school handwork, will probably be found helpful to the inexperienced.

1. ***American Whitewood*** (***Liriodendron tulipifera***, L.).—The most extensively used wood in school handwork. The wood is light, easy to work, clean-looking and even-textured, and it may be stained, stencilled upon, painted, or polished with excellent results. It is largely used for all kinds of domestic articles and

fitments, for toy making, simple scientific and mechanical apparatus, and all other forms of model construction.

The best material is light yellow in colour. Heavy, dark-coloured wood should be avoided; it is often tough, curly in grain, and difficult for children to manage. The wood is shipped from Philadelphia and other North American ports under the name of "Yellow Poplar." In England it is frequently—but wrongly—called "Basswood." The material is fast rising in price. At present boards 1 in. in thickness and 8 in. to 14 in. wide border on 5*d.* per square foot.

2. *Satin Walnut* (*Liquidamber styraciflua*, L.).—This wood is also very much used in all kinds of schools. It has practically all the good working qualities of American whitewood, but is firmer in texture, and a slightly harder wood. It is a capital wood to plane, saw, and chisel; while for work across the grain, as in wood carving and wood turning, no wood of equal cheapness can be found to yield such excellent results.

The best material is ruddy-brown in colour, without much streakiness of figure. Light-coloured wood with figure is usually rather tough to plane, etc. Its great drawback, unfortunately, is the excessive tendency it has to warp and twist. As a strip-wood for light woodwork, satin walnut is found to answer better than almost any other wood. Great care must, however, be taken to see that only thoroughly dried wood is used for this purpose, and that the bundles are stored in such a manner that the wood will not be strained into a twisted condition while in the bundle.

3. *Yellow Deal* (*Pinus sylvestris*, L.).—Common Baltic red-wood or yellow deal is also largely used in handwork. Generally the wood is light, easy to plane and chisel, etc., but there is greater variety in grain, and the working qualities of this wood are less to be depended upon than is the case in American whitewood. The appearance of finished work in deal is also less satisfactory.

The material that is best suited for handwork is very pale—nearly white—in colour, and very narrow-ringed. Knots usually occur in yellow deal in groups, about 15 in. apart; when the knots are small, and the wood is fine-grained as described above,

it gives every satisfaction in use, while the cost is less than half that of American whitewood. Dark, resinous, wide-ringed wood should be avoided.

4. *White Deal, or Spruce* (*Picea excelsa*, Link.).—The cheapest deal timber. Used in some handicraft centres, but of limited application. The large number of irregularly distributed and hard knots make it very difficult for boys—eleven to fourteen—to manage, consequently, though cheap, it is often a wasteful wood. The main body of the wood—between the knots—is fairly easy to work, smooth, white, and very glossy in appearance.

Selected, ready-planed, rectangular strips of this wood, of extreme thinness and delicacy, are now sold for model aeroplane construction under the name "silver spruce."

5. *Kauri Pine* (*Agathis australis*, St.). This beautiful New Zealand wood is well adapted for handwork purposes. Its cost, however, prohibits extensive use. The colour is yellowish-white or ecru. In general it is adapted for the same purposes as deal and whitewood, but it is firmer in working qualities than either of these woods. It is remarkable for its uniformity in grain, freedom from knots and all other defects, and the great widths in which boards of it can be obtained. Notwithstanding the price, it is a regular item on the requisition list of many schools.

6. *Red Cypress* (*Taxodium distichum*, R.) A pine-like wood, from the Mississippi basin. It is honey-yellow in colour, with fine red lines in the grain. The wood is permeated with an oily and slightly fragrant resin. This makes it a little difficult for children to work. For handwork purposes it is just about equivalent in value to a common grade of deal. It is, however, being adopted under some education authorities.

7. *Canadian Yellow Pine* (*Pinus strobus*, L.).—This well-known wood is becoming increasingly harder to obtain, year by year. Once largely used in handicraft rooms, it has been to some extent supplanted on account of the constantly rising price, and falling away in quality of the material obtainable. The wood is very light and easy to work. It is well adapted for toy making, wood carving, and all light model making. It is still in great demand in boys' schools for model-yacht construction. Its reliability has given it the place of preference for engineering pattern-making,

and it is the wood invariably used in shipbuilders' yards for the construction of the scale models of ships that are about to be built. The price of this wood has more than trebled in twenty years, and is now approximately 6*d.* per square foot (1 inch thick).

8. *Oak* (*Quercus* species).—English oak is too hard to be extensively used in school handwork. The Austrian variety of oak is much milder in grain and general working qualities. American white oak is sometimes obtainable at cheap rates, but is too hard and difficult in grain for children to manage—except in small pieces, as for inlays, etc. It is desirable to have a board or two, for such uses, and for reference and experiment.

9. *Mahogany* (*Swietenia mahogani*, L., and *Khaya senegalensis*, A. Juss.).—The Honduras wood is pale pink—nearly white—when sawn from the log. It acquires a golden-yellow colour as it seasons, which still further deepens with age. Much of the wood is too cross-grained and figury for any general use in handicraft, and it is necessary to particularly specify that straight-grained material must be supplied. It is a good wood to use in science work, inlays, trays, etc.

African mahogany is generally a dark reddish colour, and is more highly figured and cross-grained than the American varieties. The straight-grained material in both is very strong, and, compared with its density, etc., very easy to work. Its behaviour while cut across the grain places mahogany in the front rank of woods adapted for wood carving and wood turning. Where formerly the whole of the English mahogany imports were from Central America and the West Indies, more than 50 per cent. of the mahogany now used is imported from West Africa.

10. *Havana Cedar, or Mexican Cedar* (*Cedrela odorata*, L.).—This is the well-known cigar-box wood. It is very soft, light, and easy to work. Having nearly the same general appearance as mahogany, it is much more straight-grained and considerably cheaper. The end-grain of the wood planes badly and is liable to tear out. It does not behave well in being bored through with a centre-bit, but splits easily. It can be shaped well with a knife, and is therefore excellently adapted for toy making. Used largely for lining fancy metal cigar boxes, for glove boxes,

for entomological boxes and cabinets, and for the interior fittings of wardrobes, escritoires, etc.

11. *Teak* (*Tectona grandis*, L.).—A dark brown wood, tinged with yellowish green. The wood has a greasy feeling, arising from an oleo-resin that permeates its substance. To this is due its water-resisting and durable qualities. Largely used for the woodwork fittings of ships and of public buildings. If straight-grained it is fairly easily worked by scholars, twelve to fourteen years of age. Useful to employ in small pieces, and for observation, reference, and experiment (Plate XL.).

12. *Swedish and Russian Birch* (*Betula alba*, L.).—White birch has been used considerably in schemes of school handwork, more particularly in "sloyd" work, and in variations of the famous Swedish courses. The wood is greyish-white in colour, very uniform in grain and texture, and moderately hard to work. It is well adapted for fine shaped work, as seen in spoons, bowls, etc., and for general turners' work. It is imported largely from the Baltic for use as builders' putlogs (or scaffold supports), in which form it is easy to obtain, and cheap to buy.

13. *Black walnut* (*Juglans nigra*, L.).—This North American wood finds a place in most handicraft (woodwork) rooms. Its large use for house furniture is sufficient to claim a place for it in any broad scheme of work, while its dark brown colour makes it a desirable acquisition as a wood of contrast. It is too hard, on the whole, for children under thirteen years of age to work successfully, except in small or narrow pieces. It is an excellent wood for turning, and few woods look better when polished, beeswaxed, or even when simply oiled.

14. *Padouk* (*Pterocarpus indicus*, Willd.).—This brilliantly coloured red wood, obtained from the Andaman Islands, is too hard and difficult in grain for children to use in large pieces. It is also rather expensive (see list.) Small pieces are valuable for fancy frets and inlays. Its value as a means of direct association with matters geographical and colonial is obvious.

15. *Ebony* (*Diospyros* species).—The well-known black wood—used for piano keys, rulers, paper knives, trinket stands, etc.—is obtained from India, Ceylon, and West Africa. It is too hard and too expensive to be supplied to children for any but the

smallest uses. It is, however, very desirable that working pieces of the wood should be available for practical observation and experiment. Along with boxwood it is one of the woods in common use that is heavier than water. Its specific gravity averages 1·15.

Storing Timber in the School Building.—Timber cannot be economically or conveniently handled at a school building unless some special provision is made for its storage. The odd corners of staircase landings, the tops of cupboards, and the open roof timbers of a building do not afford suitable storage. They are positively dangerous from many points of view, and their general inaccessibility affects organisation adversely.

In most modern handwork rooms and handicraft centres a special timber store-room is provided. Such a room may be a partitioned-off space of approximately 15 ft. by 6 ft., at one end or side of the building. It should be provided with racks.

The type of timber rack recommended is shown in the accompanying illustration In this rack all boards are stacked on end.

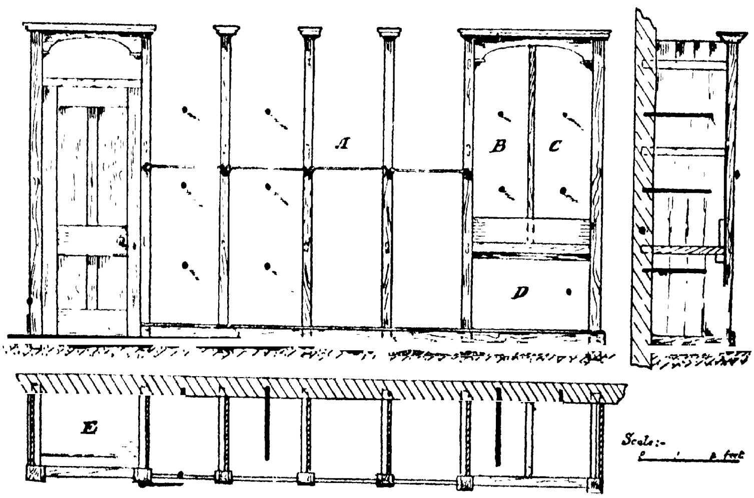
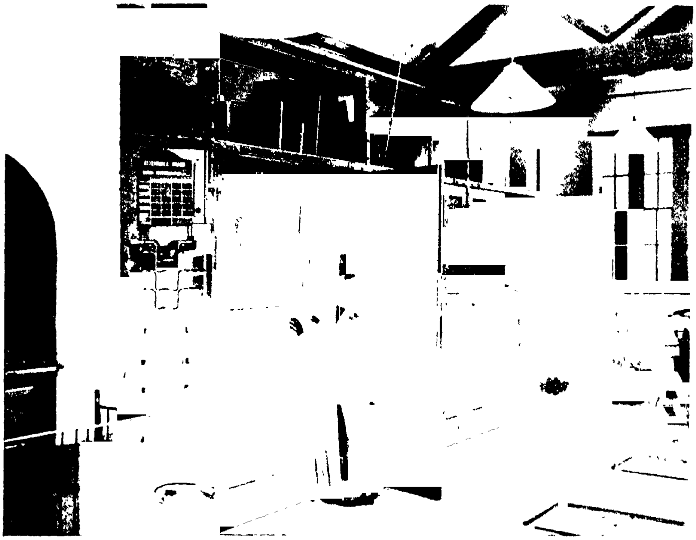


FIG. 2. DRAWINGS OF A RACK FOR TIMBER STORAGE

A. Stalls for large boards.
B, C. Stalls for short boards and ends.
D. Waste wood
E. Cupboard for storing special wood, and accessories.



STORAGE RACK FOR TIMBER IN A HANDICRAFT ROOM

TYPICAL WASTE WOOD FROM HANDICRAFT CENTRE
(Foot rule in front).

SCHOOL CHILDREN PREPARING LAND FOR PLANTING TREES

Courtesy of Board of Agriculture *Permission of Controller H.M. Stat. Office*

HANDICRAFT SCHOLARS STUDYING GROWING TIMBER TREES

The edge of each board is towards the front of the rack, so that its thickness, and the amount of wood of that thickness in stock, may be seen at a glance. Each division or stall in the rack is intended to hold one thickness of wood only. Unused boards should be kept tight over towards the right in each stall, the "board in use" being kept on the extreme left.

To prevent boards from accidentally falling outwards, an iron safety hook is fastened across each stall-opening, at 4 ft. above the floor. Except when a board is being withdrawn, the safety hooks should always be kept fastened.

A more elaborate and neater form of the same rack is shown in the illustration on Plate XLI. In this case the wood is quite enclosed, while the doors add greatly to neatness of appearance. The cost of this rack is, of course, greater.

Mode of Supplying Wood-material to a Class.—In schools where set courses of work are followed, the practice of sawing off beforehand the wood required for each lesson is not uncommon. Often this is done by the teachers or by selected monitors.

The short pieces of material are stored on shelves or in lockers, each locker being labelled with the name of the piece of work the wood is intended to make. When a class of scholars arrives, the wood is served out like so many books.

This plan saves time for teachers and scholars; it is a very economical plan in regard to the material used; but it cannot be recommended. It has the effect of placing an undesirable limit upon the scope of work that may be done by scholars; they are also deprived of a valuable opportunity of gaining first-hand knowledge of the materials used; and they are denied the exercise of the care, judgment, and responsibility that are involved in the processes of selecting, planning, and cutting out material for themselves.

From an educational point of view everything is to be said in favour of allowing scholars to cut out their own wood. Where this is done, close supervision is necessary on the part of the teacher, and some rules and precautions must be enforced if confusion in work and unnecessary waste are to be avoided.

Where a scholar is allowed to select and cut out wood, he

should first prepare, and present to the teacher for checking, a statement of the kind and quantity of material required. This statement may be drafted in the form of an "order" or invoice, and, if a list of the prices of various woods is available for reference, the cost of the material it is proposed to cut out may be calculated and entered on the form as well, incidentally securing in the best possible manner the association of useful and real problems with real work.

The scholar's order for timber and the calculation of its cost, etc., may be drafted on a form prepared by the scholar each time, or, to avoid loss of time by so many scholars upon this purely mechanical work, such slips may be printed—an excellent task for the school press where one exists. The following is a good type of form to use.

ORDER FOR TIMBER

Name of Scholar . . . .
Name of Article being made . . . .
Kind of Wood required . . . .
Cost of this Wood per square foot (1 in. thick) . . . .

Length.	Width.	Thickness.	
. . . . ×	. . . . ×	. . . .	Actual cost of this material . . . .
. . . . ×	. . . . ×	. . . .	(Show working here or on back)
. . . .	. . . .	. . . .	

Initials of Teacher . . . .   Date . . . .

A modified type of the above form is largely used in London handicraft centres, and is found to be very satisfactory.

In evening classes, where the cost of timber used is charged to students, a form of this kind is essential and may with advantage be issued in duplicating carbon books of the usual business kind.

Rules for Cutting Out Wood.—1. It is a good plan to have only one board, out of each thickness of material, in use at one time. Where scholars have permission to select wood from a rack, the importance of such a rule is quickly evident unless this stipulation is enforced.

2. Narrow boards of a given thickness should be first brought into use. Wide material in every thickness should be kept until the last, lest occasion for the use of a wide board should arise

and none be available. Wide boards can quickly be made into narrow ones, but time and trouble are necessary to join up narrow boards into wide ones.

3. Where possible, cut narrow strips of wood out of the boards that are warped badly (if any such exist), so using up all warped boards as quickly as possible, and not placing them aside, as there is sometimes a temptation to do.

4. Saw along the grain first. In sawing a rectangular piece from a board or plank, two cuts are necessary (see numbers 1 and 2 in Fig 3). It is highly important that cut 1 should be made first. If cut 2 be made first, the piece is very liable to break across the corner as shown, and is then in the majority of cases spoiled for the purpose intended.

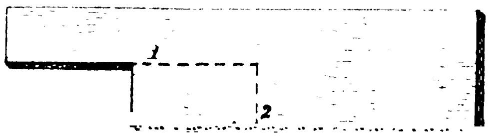


FIG. 3. CORRECT SAWING.

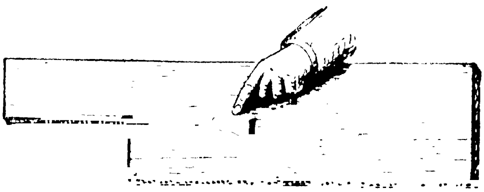


FIG. 4 INCORRECT SAWING

5. When a new board is taken, begin the sawing at the best end and on the best side. This rule ensures that any defective material (which by inference exists at the opposite end) is contained in the odd waste end that is usually left when the board is used up.

Estimating and Controlling the Cost of Timber. Wherever school woodwork is taken, the cost of timber is naturally a rather heavy item in the working expenses of the school

It is clear that for the same number of scholars under instruction the cost will be greatest where large pieces of wood are used and large objects made, upon which a minimum of tool-work is done. And the converse of this is obviously true—that where the maximum of tool-work is done to each piece of wood, there the cost of timber will be smallest.

If, for example, a number of scholars are each allowed a piece of material, 12 in. × 4 in. × $\frac{1}{2}$ in., for use in one lesson, and the

timber requisition is calculated on this basis of allowance, it is obvious that by increasing the amount of tool-work to be done to this piece of wood—that is, by altering the design, application, or mode of construction of the article to be made—so that the piece is made to last for two lessons, the timber bill in regard to those scholars is by this means halved.

This principle can, of course, be taken too far. Undue delay and over-elaboration of an article that would function just as effectively in more simple form is liable to be destructive of the interest that scholars may have in the content.

An effective and economical method of dealing with large and quickly executed work is to invite scholars to bring wood themselves for such purposes. Dry-goods boxes are to be had at very cheap rates at most grocers' and provision merchants' shops. A good deal of rather poor-grade and almost unworkable material is used in some of these packing-cases, but much excellent wood is contained in them also, as, for example, that used in the butter-packing boxes from Queensland and New Zealand.

For average work in a woodwork class a reasonable provision is to allow for timber at the rate of ½*d.* per scholar per lesson. This does not provide for large and quickly made objects upon which little work is done.

Straightening Warped Wood.—A board that is quite flat before planing sometimes becomes badly warped after the surfaces have been removed. In school woodwork this is often a cause of great disappointment to a scholar. Flatness can generally be restored by holding the round (convex) side towards a fire, and damping the hollow side (see Fig. 5 A). When the warp has been removed, the board should be kept flat by heavy weights (see Fig. 5 B), or by being placed between slat-bearers, as in seasoning, until it is quite dry. It should then be fastened into its final position before warping begins to set in again.

Steaming and Bending Wood.—Under the influence of great heat and moisture, the cells of wood soften slightly, and the wood becomes to a limited extent pliable (see Fig. 5 C). If the wood is then held down in any bent or twisted condition until it is dry (see Fig. 5 D), the cells become set and stiff in the new positions, and the wood shows little or no tendency afterwards

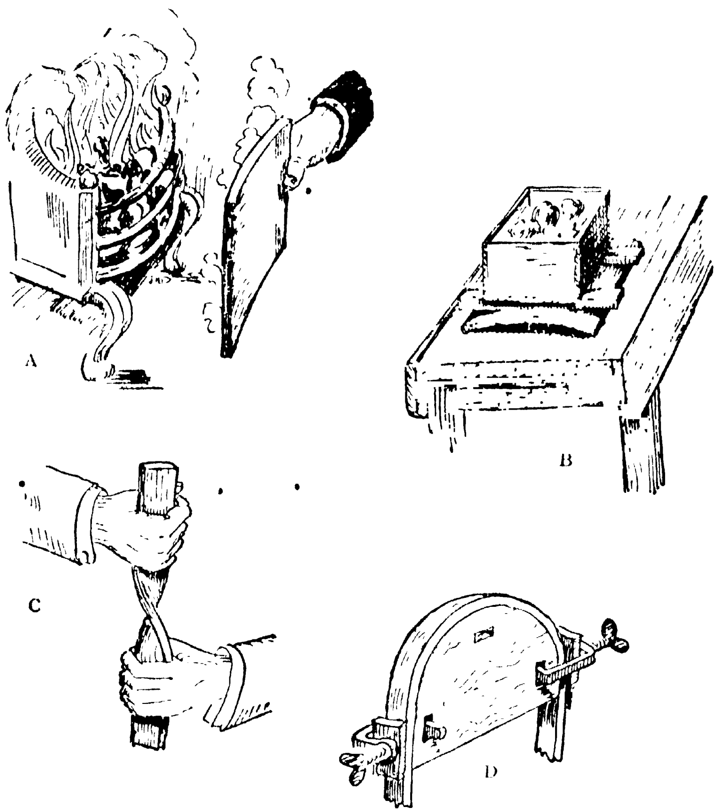


FIG. 5. MEANS OF BENDING WOOD.

to return to its former shape. Thus walking-stick handles may be bent to the required shape, after being placed in boiling water from one to two hours. Most kinds of soft wood strips may be bent, when not above a quarter of an inch thick, after sponging with boiling water for ten minutes. Long strips are more difficult to manage because of the want of long-shaped boiling vessels. A six-feet section of rain-water pipe, with one end stopped up, does well in the absence of more suitable provision. Boat-ribs are usually steamed in a long box, and become pliable under the action of superheated steam in a very few minutes.

The rods of green hazel, etc., that are used in pack-carriers, fish baskets, cowels, etc., are bent after a severe scorching at the

points where bends are required against an open fire. The green wood contains all the moisture needed, which, under the action of the fire, gives the equivalent of boiling at the bends.

Finishing Wood Surfaces.—The appearance of articles left in natural wood is not always satisfactory. Under the effects of light, dust, and frequent handling, the pristine, clean appearance of new wood is soon gone. Hence the wide use of stains and polishes. These preserve the wood and often improve the richness and lustre of its figure. Further, wood that is polished is more hygienic, and its stability and anti-hygroscopic qualities are very greatly enhanced.

Liquid stains of all colours, ready to apply, can readily be obtained from all oil and colourmen's stores. Lacquers in all colours, for wood and metal, are also obtainable from the same firms.

As a rule, attempts to stain and polish wood in one process by the application of one liquid only are not very successful. A new material for which much is claimed is "Polivar." It is sold in several colours at 1s. to 1s. 6*d*. per bottle, according to colour, and can be obtained from oil and colour chandlers

Wood-material for Light Woodwork and Toy Making.—This material is obtainable in the form of square sticks and slabs of very small dimensions. The material is accurately planed (or finely sawn) to certain standard dimensions that are set out below. For convenience in handling, both in class use and in storage, the sticks, strips, and slabs are supplied in lengths of 2 ft. an are done up in bundles of 100 (See Plate XL.). Sizes and cost:

	s.	*d.*			*s.*	*d.*	
$\frac{1}{4} \times \frac{1}{4}$ in. . . .	2	0	per bundle.	$\frac{1}{8} \times \frac{3}{8}$ in. . . .	2	9	per bundle.
$\frac{3}{8} \times \frac{3}{8}$ in. . . .	3	0	,, ,,	$\frac{1}{4} \times \frac{1}{2}$ in . . .	3	0	,, ,,
$\frac{1}{2} \times \frac{1}{2}$ in. . . .	3	3	,, ,,	$\frac{1}{4} \times 1$ in. . . .	4	0	,, ,,
$\frac{1}{4} \times 2$ in. . . .	6	0	,, ,,	$\frac{1}{4} \times 3$ in . . .	8	0	,, ,,

The above range of sizes can be obtained in satin walnut, yellow pine, American whitewood, and maple. Flat sheets of veneer woods, of extreme thinness, and ordinary thin boards are also largely used, the approximate cost being: Pine veneer, $\frac{1}{16}$ in. thick, 9 in. wide, 10s. per 144 ft. lineal. Whitewood or maple veneer, 2*d*. per ft. super. Thin planed fretwood boards:

Thickness	$\frac{1}{8}$ in.	$\frac{3}{16}$ in.	$\frac{1}{4}$ in.	$\frac{3}{8}$ in.	$\frac{1}{2}$ in.	
Satin walnut	4*d*.	4½*d*.	5*d*.	0*s*. 5½*d*.	0*s*. 7*d*.	per
Kauri pine	6*d*.	7*d*.	8*d*.	0*s*. 10*d*.	1*s*. 0*d*.	foot
Mahogany	7*d*.	8*d*.	9*d*.	1*s*. 0*d*.	1*s*. 2*d*.	super.

Three-ply Alderwood boards in large squares (for cutting down, or as base-boards for mounting assembled models, scenes, etc.) may be had in any thickness from $\frac{1}{8}$ in. to $\frac{1}{2}$ in., increasing by sixteenths:

Thickness.	Size of Sheet.	Price per sq. foot.
$\frac{1}{8}$ in.	47 × 38 in.	¾*d*.
$\frac{3}{16}$ in.	53 × 34 in.	1*d*.
$\frac{1}{4}$ in.	72 × 48 in.	1¼*d*.
$\frac{3}{8}$ in.	46 × 37 in.	2¾*d*.
$\frac{1}{2}$ in.	36 × 24 in.	4*d*.

Three-ply boards 48 in. × 36 in., *faced one side with mahogany, oak, or walnut*, and $\frac{1}{4}$ in. thick, cost 3*d*. per square foot.

Round dowel rods in beech and birch, $\frac{3}{16}$ in. to $\frac{7}{8}$ in. diameter, and 36 in. long, cost 3*s*. to 10*s*. per 100.

A special line of material, thin parallel strips of pine veneer and slender matchwood, $\frac{1}{8}$ in. × $\frac{1}{8}$ in., for use in kindergarten and lower-standard handwork, can be obtained. Boxes for scholars, each containing 700 strips, dyed in various colours, and a tube of liquid glue, are supplied at 1*s*. each (1*s*. 2*d*. nett, post free). This material may all of it be cut to length, shape, etc., with ordinary school scissors.

Specially selected light sticks, in several woods, and thin pine veneer (wafer wood), for model aeroplanes, are also procurable.

The cheapest materials it is possible to get are the sawn laths that builders use. These can be got from builders' and timber merchants' yards at a cost of 9*d*. to 1*s*. per bundle of 100. Each lath is 3 ft. 6 in. × 1 in. × $\frac{3}{16}$ in.

Wood for Turnery.—In handwork rooms where a lathe or lathes form part of the equipment, woods of rectangular section must be requisitioned. The sizes will be governed by the kind of work it is proposed to do. A good scope is afforded by pieces 1½ in., 2 in., 2½ in., and 3 in. square. These sizes may be obtained in nearly all the woods mentioned below, from most timber merchants.

There should also be provided some 1½-in. and 2-in. plank material, in lime and pine, for face-plate work (masher-heads,

patterns, etc.), while wide boards (10 in. to 15 in.) in oak and mahogany, from ⅜ to ¾ in. thick, will provide opportunities for turning picture-openings in wide panels (if the lathe-head is reversible and an outside rest is attached to the lathe), and other work of that type.

The following woods are those most useful:

Yellow deal, for practice work, round sticks, legs of stools, etc.

Maple, beech, lime, sycamore, for mashers, platters, spoon-handles, etc.

White and red birch, for mashers, platters, spoon handles, etc.

Mahogany, walnut, and oak, for ornamental turned work generally, legs of stools, chairs, tables, solitaire stands, etc., and also for the flat (face-plate) work referred to above.

Satin walnut, one of the easiest woods to manage, and adapted for a very wide range of work.

Ash, for handles of tools, cricket stumps, etc.

Sawn squares, in sets of four, may be obtained from timber merchants at about the following prices *per set*:

Size	Length	Satin Walnut		Oak		Mahogany or Walnut	
		s.	*d.*	*s.*	*d.*	*s.*	*d.*
1½ × 1½ in.	18 in.	0	5	0	6	0	10
2 × 2 in.	18 in.	0	9	0	10	1	5
	36 in.	1	5	1	10	3	6
2½ × 2½ in.	16 in.	1	0	1	4	2	2
	36 in.	2	3	2	8	4	6
3 × 3 in.	16 in.	1	6	1	8	3	0
	36 in.	4	0	4	6	6	4

The prices for intermediate lengths may be approximately calculated from the above data.

Woodworkers' Accessories.—Sooner or later, in every woodwork room, the need of one or more of the following types of standard semi-prepared material arises. As they fall more naturally under the general heading "Timber" than under any other section, they are referred to here.

1. Sash-bar mouldings, for school cold frames, deal.
2. Picture-frame moulding, all widths, in all woods.
3. Moulding for tray edges (special shape).
4. Small bolection moulding in all hard woods (for frames of display cases, small caskets, etc.).

5. Small carved and pressed ornamental mouldings, for any small fancy work.

6. Small turned pillars, all lengths, with or without separate caps and bases.

7. Turned table legs and centre pillars, in all woods.

8. Tiny turned mouldings, bead and ball, pearl rope, fluted, reeded and twisted beading.

9. Draw knobs, buttons, pateræ, knob-legs, and finials.

10. Turned circular and oval portrait frames, natural or black.

11. Shell, fan, urn, and trophy designs, already inlaid (marquetry), for use in Sheraton work.

12. Prepared banding and lines for panel borders, in boxwood, ebony, tulip, zebra, holly, and satinwood.

13. Plain and figured veneers in every kind of wood, sold in sheets, 2 ft. to 6 ft. long, averaging 1 ft wide.

14. Three-ply wood, in sheets a yard square, faced on one side with oak, walnut, or mahogany veneer.

15. Grooved and moulded casing, for enclosing all kinds of electric wire-work.

The above materials may be obtained at any large wood-turning and moulding works at very cheap rates.

Utilisation of Waste Material from Handicraft Rooms.—In the conduct of every woodwork room some amount of waste material is a sure by-product. Odd ends, waney corners, and cross-grained and knotty, unworkable pieces accumulate in time. Some proportion of spoiled or unpassed work must also be added to the list, even where the best of intention and supervision exists. When all kinds of handwork materials are so dear, it seems a pity that some better use than fire-lighting is not made of this solid, strong, and durable waste product.

Generally it is very misshapen material, and it certainly would not pay to have it resawn to parallel shapes by any outside labour; new wood would be cheaper. It could be accurately redressed on a small-power circular saw on the school premises; but circular saws, foot or power, are very dangerous for children to operate, especially with short, lumpy bits of wood. A small hand-power reciprocating jig-saw is probably the most effective solution. The saw should be fitted with a wide-webbed blade,

and the bed should be grooved to carry a sliding carrier. With such a machine much material now wasted could be re-used in smaller sizes; the machine would be a permanent object-lesson in mechanics, and, if narrow saws are also supplied, a large range of work of an artistic nature will be added to the curriculum of the woodwork room. The saw is not dangerous to use.

Another plan for utilising the waste wood is to place the material at the disposal of the infants' school. Some of the rectangular waste pieces from London handicraft centres are disposed of in this way. But pieces of any shape and size are welcomed by many teachers in infants' schools, and afford excellent scope for imaginative building work with children from three to five years of age. The pieces may be stored in a large dry-goods box, and when very soiled may be burned, and a fresh supply obtained. The unforeseen variety of the fresh supply is always invested with new charm and extended possibilities in the eyes of the children (see Plate XLI.)

Some attempt has been made to nail and otherwise fasten the odd waste pieces in the form of walls, houses, castles, and a variety of other objects. This invests the construction, whatever its type, with an aspect of permanency and seriousness of aim. It is strongly suggested that this is an overstrained use of such misshapen and odd material, and that the technical difficulties of arranging such material and fastening it in position are very great, and are calculated to cause an extravagant loss of time as compared with result values obtained by the children.

On the other hand, the absence of such technical restrictions when using the loose material allows the freest use of imagination, a wide scope of application, and a maximum range of construction in the minimum of time.

Rustic Woodwork.—The twigs and branches used in rustic woodwork should be collected in winter. If gathered in the summer-time, the bark on some kinds is liable to peel off, and summer-gathered material of all kinds is more liable to become rotten if stored in a damp place.

For general school work, small branches and stocks, from ½ in. to ⅝ in. thick at bottom ends, are most useful. These should be tied up tightly in bundles 1 ft. in diameter for storage.

In November the prunings of fruit trees, hedgerows, plantations, etc., and the undergrowth of woods may often be had for the mere asking. In many districts brushwood faggots are to be obtained cheaply from wood and copse clearings in the spring-time. Larger wood—for pergolas, arches, seats, and summer-houses, may be obtained from most country timber merchants and forest agents.

Packing-box wood is suitable for bases, etc., and can be had at grocers' shops. Virgin cork is sold at oil and colourmen's. Oak and alder lichen, reeds, grass, and moss may be gathered in summer and stored in a dry place till needed.

The kinds of twigs most suitable for rustic work are :

1. Hedgerow, scrub, or copse elm. This is the best material procurable. The bark on the twigs and small branches is usually covered with thick cork-like protuberances, which greatly enhance the rustic appearance of the work

2. Oak, apple, pear, and cherry twigs. From the crookedness of the twigs these afford some scope in artistic arrangement.

3. Willow, osier, hedge-sallow, birch, and common elm. The twigs of these trees are very pliable and are useful for over-binding and filling in.

4. Ash, alder, beech, hazel, hornbeam, horse-chestnut, lime, mountain-ash, plane, and poplar. These are usually straight, smoothed-barked twigs yielding rather plain effects, and liable to split badly if nailed without adequate boring.

5. Black and white thorn, holly, and gorse. These are difficult to work and thorny to handle, but they afford pleasing knob-like effects when arranged with care, and with due regard to the characteristics of the twigs.

Arbor Day.—*Planting Timber Trees* (See Plate XLII.). This school occupation is not new From its association with timber production and the uses to which timber is put, it is briefly treated in this article.

The tree-planting movement is very popular in American schools ; and most European countries are affording facilities and encouragement to schools and associations that wish to put the principles of afforestation into practice, on however small a scale.

To compensate for the rapid depletion of forests, and also with a view to enhancing the value of the treeless prairie districts of the United States, an Act of Congress was passed in 1873 called the "Timber Culture Act." By this Act the planting of 40 acres of land conferred upon the planter a free title to 160 acres of the public domain. As an alternative, in many States (and also in some portions of the Dominion of Canada) a money bounty and exemption from certain taxes is allowed, provided certain suggestions, made in the authorised scheme of tree-planting, are carried out. Trees are inspected three years after planting, and the bounty is allowed on all trees that have taken well to the soil.

The movement is focussed, in the various State schools, by the institution of a set day for planting, to which the name "Arbor Day" has been given. The inception of this movement was due to Governor Morton, of Nebraska, and it was inaugurated by the State Board of Agriculture of Nebraska in 1872. Its adoption as a day of national holiday for adults, as well as for school children, is being strongly promulgated.

Generally the date of the Arbor Day holiday is fixed by the State Board of Education, by the Superintendent of Public Instruction, or by the Governor of the State. In some States a day in the autumn is chosen; in others, especially in the more northerly States, the springtime is preferred.

Tree seedlings are supplied at nominal cost, sometimes free, by the State Forestry departments, or by the various Forestry Associations. Where seedlings are not given, seeds are supplied on request.

BOOKS FOR REFERENCE

G. S. Boulger: *Wood* (Edward Arnold). P. Wells: *Soft and Hard Woods* (London, Percival Marshall). *The American Woods* (R. B. Hough, Lowville, New York). The Forestry Publications of the Department of Agriculture, Government Printing Office, Washington, U.S.A. J. Hudson-Davies: *History and Characteristics of Timber Trees.* Articles and Timber pages in *Work* and in *Building World* (Cassell & Co.).

[*N.B.—Any teacher who has difficulty in procuring timber will be supplied with a list of timber merchants, in various parts of the kingdom, on sending a stamped (halfpenny) addressed envelope to the Caxton Publishing Co.*]

XLI. HOW TO ADAPT ORDINARY CLASSROOMS FOR HANDWORK

By J. B. Robinson

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The Need for Adaptation.—The present-day classroom, fashioned and furnished chiefly for book study, makes at best an inconvenient laboratory; but no doubt when thought and action, knowing and doing, each come to occupy their true relative positions in our conduct of education, the classroom will be designed as a place adapted not only for bookish pursuits but also for education through constructive activities. Till then, makeshift contrivances must serve, and even with them the journey on the road leading to a "new education" classroom will be hastened.

The special woodwork room, with its special teacher, is not an unmixed blessing, and its evils are exaggerated when it exists as a "centre" at some distance from the main building; but it seems that in thinly populated areas either the "centre" system must prevail, or else some other handwork subject, not requiring an exorbitant expenditure, must be found to take the place of woodwork. In some rural areas light woodwork is so employed, and by light woodwork is meant that form which uses as a medium strips and prepared material of a light nature.

Light woodwork is a good introduction to, but it must not be a substitute for, ordinary woodwork, and therefore the contrivances subsequently described, while dealing with handwork subjects generally (including light woodwork), yet offer a solution of the difficulty encountered in providing older boys with woodwork proper when no special room is available.

The handwork occupations usually practised by junior classes

can be prosecuted with a reasonable degree of success on the ordinary school desk; but to expedite distribution and collection, the storage and translation from room to room of the many tools and materials demands, for comfort's sake alone, some special consideration.

Boxes for Tools and Materials.—The tool boxes herein described are converted packing cases procured from a local grocer. These being of a strong substantial character, built of ¾-in. wood with dovetailed joints, and measuring about 19¾ in. × 14½ in. × 6¾ in. internally, can, with little constructive skill and at small cost, be transformed into serviceable receptacles for tools and materials. Where necessary or desirable the lid might be battened, attached to the box with a pair of bands, and fitted with a padlock; while the addition of a coat of paint will make the whole presentable.

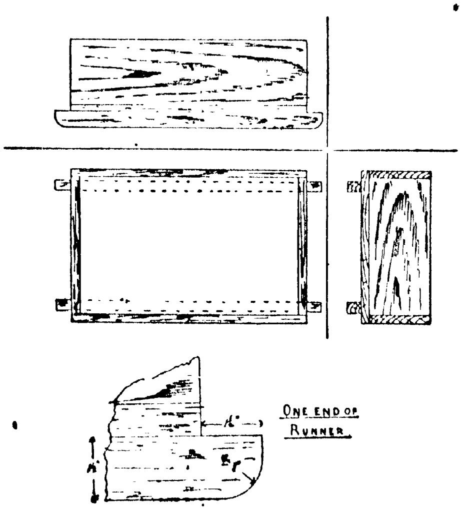


Fig. 1

Having secured a box (complying with the above description) which is capable of containing a hundredweight of clay, it may be made watertight and waterproof by applying to its interior one or two thick coatings of tar. The addition of a rope and a pair of runners enables it to be moved with tolerable ease from place to place. The runners, each 24¼ in. long, 1½ in. high, and 1 in. thick (Fig. 1), should be of hard wood, preferably beech, rounded on the lower corners and attached to the box by means of screws, the heads of which are countersunk.

A similar box may be used for holding the cardboard-work tools. It is divided into seven compartments (Fig. 2). The first compartment is 12½ in. × 3 in., and holds sixty wooden rules;

the next is 12½ in. × 5½ in., and is made large enough to contain sixty safety straight edges; and a narrow division contains adhesive brushes. The compartment for sixty set squares is 7¼ in. × 5¼ in.; while two equal spaces, each 7½ in. × 3¼ in., are provided for sixty knives and sixty pairs of scissors. The remaining irregularly shaped division holds the necessary jars of adhesive. A pair of rope handles should be attached to the ends, and thus a storage place and a means for easily transferring or readily distributing the equipment are made at one and the same time.

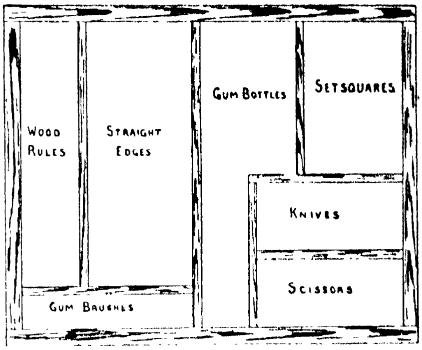
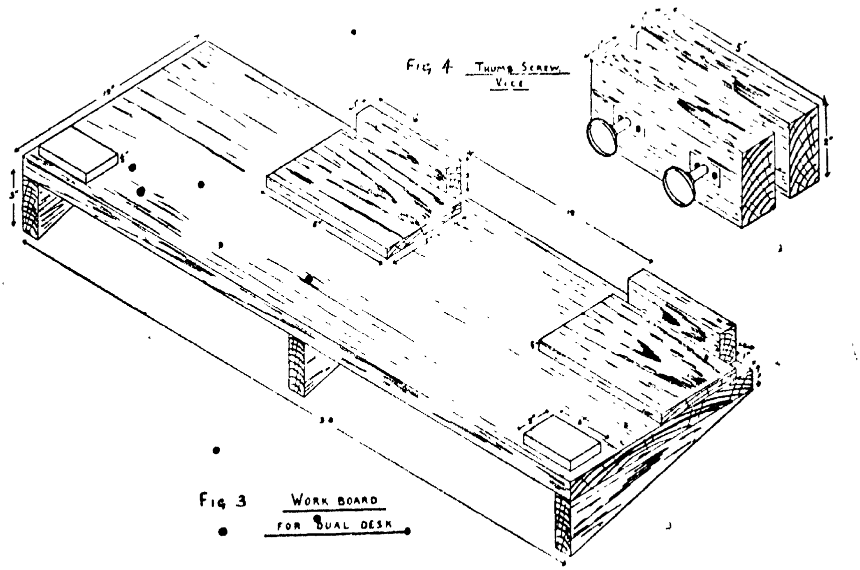


FIG. 2

Improvised Benches.—That branch of woodwork previously referred to, where prepared material in the form of strips and thin wood is used, is usually practised without great difficulty in



the classroom; but an appliance which when placed on the usual sloping desk produces a horizontal surface is highly desirable, and for work of a high order, essential. Such a piece of apparatus is illustrated in Fig. 3. This accommodates two workers, and is intended for use on a dual desk; but reduced in measurements, and following the same method of construction, it may be made to supply the requirements of a single pupil.

Redwood may be used in its construction, though birch would be more durable, and more expensive. The board itself is 3 ft. long by about 12 in. broad. Three tapered cross-pieces added below neutralise the slope of the desk. A sawing block, a cutting board for chiselling, and a piece of sheet iron about 3 in. × 2 in. for clinching nails, are screwed on for each boy. Two thumb-screw vices may be added if desirable (Fig. 4). The farther block of this vice should be screwed to the front edge of the bench top, and placed in such a position that it receives the support of one of the tapered cross-pieces. In order to keep the board steady when in use, two pieces of wood, each 5 in. × $\frac{3}{4}$ in. × $\frac{3}{4}$ in., are screwed to it in such a way that they slide into the slate slots of the desk.

It will be noticed in the illustration that the worker is ex-

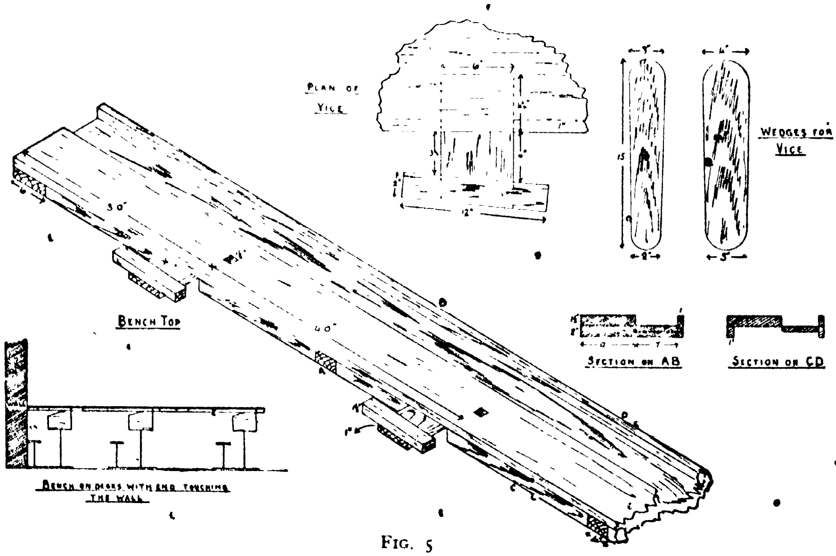


Fig. 5

pected to stand between the desk and the seat. This is inconvenient, and where a large floor space is available, it would be advisable to turn the board from back to front on the cross-pieces, and, by drawing the desks apart, allow the pupil to work from the front of his desk. The tools required by the pupils may be packed in boxes similar to those described later.

The improvised bench shown in Fig. 5 and Plate XLIII. makes it possible to carry on instruction in a form of woodwork superior to that previously provided for. This will be richer in manipulations and broader in treatment; and even though a special room with special furniture be not available, yet it will not be less valuable through lack of these, but will retain all the most desirable features of ordinary "heavy" woodwork. The bench is of red wood, unlimited in length, and 17 in. wide. The top board is 9 in. × 1½ in., while an inch piece forms the floor of the well, and is sunk into the cross-pieces, giving a depth of well of 1½ in. The cross-pieces are 16 in. × 4 in. × 2 in., and strips, 2 in. × 1 in., are fixed at the front underside of the plank to prevent motion away from the worker. The vice, the old-fashioned wedge, consists of two pieces of beech screwed together and to the bench, all screws being driven from below. In use, the apparatus may be placed either longitudinally on a row of desks, or transversely over several rows; if the former, the rows must be drawn apart to provide room for the workers between them; and if the latter, the workers stand in the passage way between the rows. In either case clamps may be necessary to prevent rocking, and one end must be jammed close to the wall to resist the thrust of planing.

Fitting the Bench to the Child.—The height of the bench should be slightly below the elbow of the worker; but, seeing that the height of the desks on which the benches are placed cannot be adjusted to suit individuals, the pupils should be grouped according to height, and, if need be, elevated on platforms made of planks nailed to blocks of wood.

Groups' Tool Boxes.—When such benches are used, one tool box will be needed for every four boys, and two others for the tools used in common by the whole class. The box for four boys is illustrated in Fig. 6 and Plate XLIII., and is divided into four compartments

by strips of wood 2½ in. high and ⅜ in. thick. The division for four saws is 15 in. × 2⅝ in., for four planes 14⅜ in. × 11½ in., for four try squares 4⅜ in. × 2⅝ in., and for four gauges and

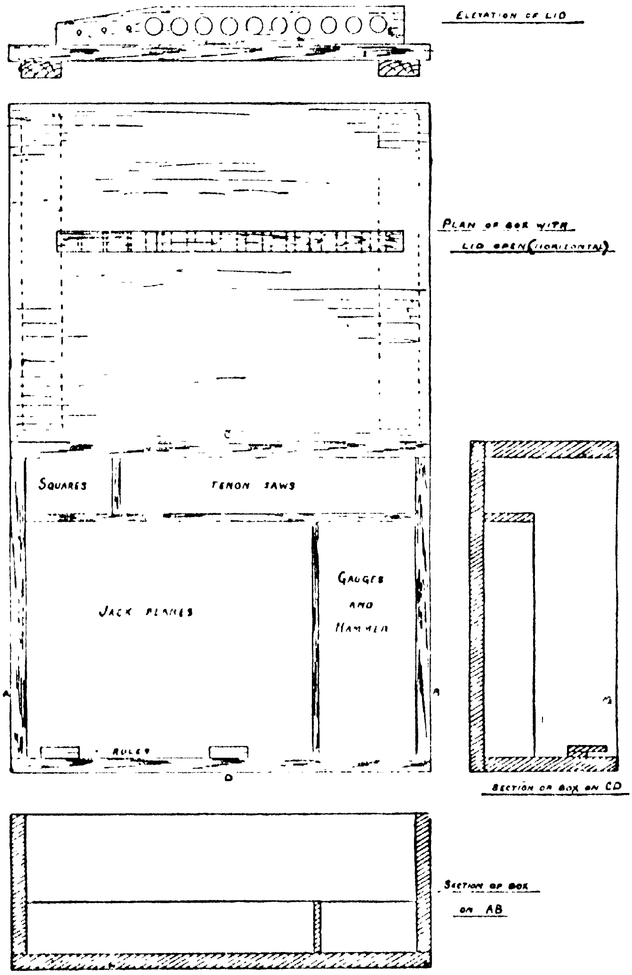


FIG. 6

one hammer 11½ in. × 5 in. Two notched pieces of wood are screwed to the inside of the front to hold four steel rulers, and a like number of bench hooks lie on the top of the other tools. A

rack is screwed to the inside of the lid to hold one knife, one pricker, one screwdriver, two marking knives, and four $\frac{3}{4}$-in., one $\frac{1}{2}$-in., one $\frac{3}{8}$-in., one $\frac{1}{4}$-in., and one $\frac{3}{16}$ in. chisels. The rack is tapered, and placed in such a position that it clears the tools in the box. When in use the lid of the box is held open, just past the vertical position, by a strong cord fastened to two screw eyes, one on the inside of the box and the other on the lid.

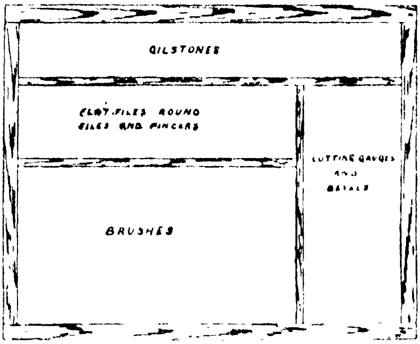


FIG. 8

The divisions of the first general box are represented in Fig. 8. That marked "oilstones" is $19\frac{3}{4}$ in. × $3\frac{1}{2}$ in., and contains two oilstones set in wood, and one oilstone slip. The part marked "files" is $14\frac{3}{8}$ in. × $3\frac{1}{2}$ in., and holds two flat, two round and two half-round files, and two pairs of pincers. The compartment for brushes is $14\frac{3}{8}$ in. × $7\frac{5}{8}$ in., and contains five small brushes to be used in clearing up. The remaining portion is $11\frac{1}{2}$ in. × 5 in., and is allotted to two cutting gauges and two bevels. A bow saw lies on the top of all, and on the inside of the lid a rack holds six gouges of various sizes, and three spokeshaves. In the second box of general tools (Fig. 9), the long compartment, $19\frac{3}{4}$ in. × $2\frac{5}{8}$ in., accommodates a brace; the largest division, $11\frac{1}{2}$ in. × 6 in, is set apart for two smoothing planes lying on their sides; and the space for "bits" measures $6\frac{1}{2}$ in. × $4\frac{1}{2}$ in. and contains five centre bits, two shell bits, one countersink bit, and two nail punches. Store room is also provided for screws and nails in the six small divisions, and for a

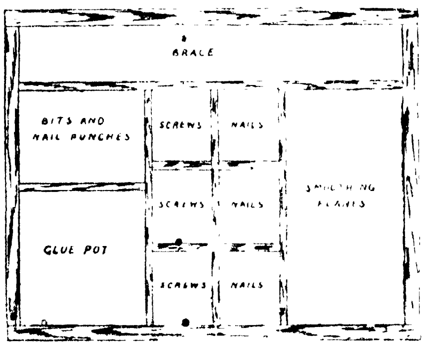


FIG. 9

glue pot in the square division. Loose tools yet unstored are one rip saw, one cross cut saw, one sawing stool, and two mallets.

A Large Clay-modelling Board.—A large clay-modelling board suitable for co-operative work is an almost indispensable addition to the handwork apparatus of a school; for where modelling is used as an aid to the teaching of geography and history, its efficiency is often in direct ratio to the size of the model constructed.

Fig. 10 is a drawing of a board which, light in weight, though lacking nothing in strength, is very portable and can be placed across the tops of school desks. It is 3 ft. wide, and can be made of any length up to 5 ft. or thereabouts. The framework is of $1\frac{1}{2}$-in. × $1\frac{1}{2}$-in. redwood. The end cross-pieces are attached to the longitudinal pieces by mortice and tenon joints, while the intermediate cross-pieces are half lapped to the same. The length of the table will determine the number of cross-pieces, which should be about 2 ft. apart. Where a long table is required, the material of which the framework is constructed should be heavier. The long sides of the framework project about 6 in., to form handles.

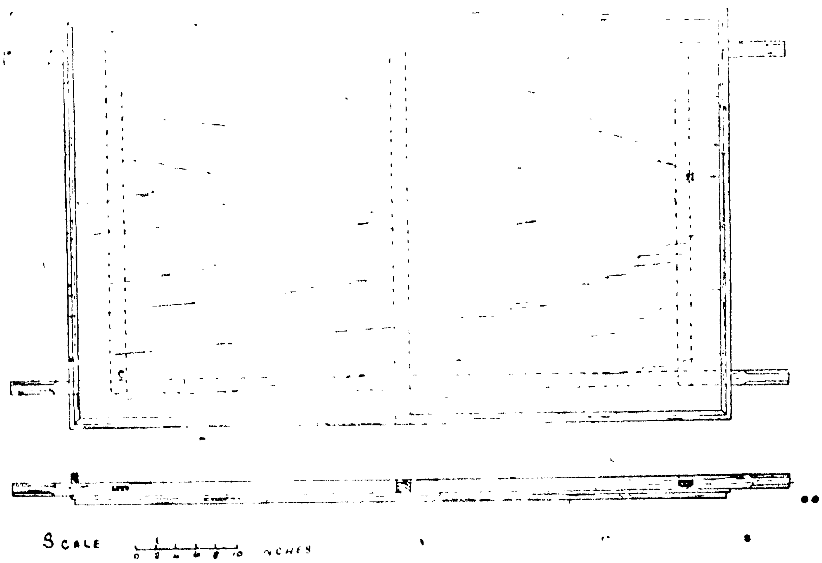


Fig. 10

The top of the table is of $\frac{1}{4}$-in. three-ply wood, and is screwed to the frame from above, using $\frac{3}{4}$-in. brass screws for the purpose, and a rim, 1 in. high by $\frac{1}{2}$ in., is screwed from below to the three-ply top, to prevent pieces of clay falling to the floor. Suitable pieces of wood, attached to the undersides of the cross-pieces of the framework, are placed in such a position that they drop into the slate slots of the two extreme desks, and prevent the whole from sliding about on the desk tops.

Cost of the Apparatus.—In designing the above due regard has been paid to the demands of economy. Where woodwork is taken by the older boys, all save the long bench top can be constructed in the woodwork room, and where this is possible the price of materials only need be taken into account in estimating costs. For the single work board the material would cost about 6*d.*; for the dual work board, 1s.; for the tool boxes, 10*d.* each; and for the large clay-modelling board, 4s. With the cost of labour added the following will be about the total cost of each: Single work board, 1s; dual work board, 1s. 10*d.*; large clay-modelling board, 6s.; converted tool boxes, 1s. 10*d.* each; while the bench top will cost about 3s. per place.

XLII. HANDWORK FOR SPECIAL SCHOOLS

By J. H. Judd, M.I.M.E.

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In the case of children diagnosed by the Schools Medical Officers as requiring special treatment and separate tuition, we may at once lay down as a correct rule that the very early teaching must be always in accordance with the well-known tenets of Froebel and Pestalozzi, or such other methods of modern times, whereby the dormant mind of the child is vivified through the sense—especially that of touch. On these lines, as a general rule, the present-day time-tables of our Special Schools of all grades are drawn up and approved, each responsible teacher being given freedom to develop the special handwork as the foundation of the education given, according to his or her own ideas of fitness, suitability, and the powers, mental and physical, of the children concerned.

This freedom of option has resulted in a plethora of subjects and occupations, many of which are useless as a preparatory stage to what must of necessity be, in the case of special school children, more or less Vocational Education.

Experience and experiment only can determine which subject is superfluous in any scheme of training which has, or should have, for its climax the fullest personal development and the greatest power of social self-support of the individual. Whilst there should be no attempt made to specialise during the preparatory stages, it should be clearly understood that to ensure future social efficiency, those principles upon which the vocational work of the senior or adult section of the school or institution is founded must permeate the whole preparatory period spent in the training-school.

How this can be done *best* without interference with the fullest development of the individual, liberty of the teacher, and vested interests, is a problem which sooner or later must be solved by those responsible for the efficient working of the new Act.

Accepting the kindergarten methods as the foundation work of the lower classes, and modifying them to meet individual needs in the upper classes, we shall relate our proposals to innovations or departures from the orthodox which have proved of value, and with some details of methods, materials, and tools employed in the teaching of such preliminary handwork as we consider distinctly preparatory to vocational and industrial occupations especially suitable for mentally defective pupils.

In passing we will assume that the power of reading necessary for pleasure or profit cannot be universally attained. One of the first essentials in the education of defectives is that habits of imitation—in lieu of habits of reasoning shall be acquired, and as mimicry is usually one of the most common inherent qualities of these "special" children, very little difficulty will be found in securing this. In some high-grade cases every effort should be made to develop the power of memory-drawing, in others latent histrionic talents demand attention and will well repay the efforts expended.

The teaching of number is a chief essential, since measurements enter into every phase of industry. Every principal teacher has his or her special way of teaching through touch, and in making the lesson fit the children, therefore it would be unwise to dogmatise and say this or that method is *the best*; but as very little progress can be made in the higher manual work without some practical knowledge of the standards of length, breadth, and thickness being acquired, the following means may be employed.

The Teaching of Measurement.—The building-up of the standard English measure of 1 ft. is taught by means of 1-in. cube hard-wood blocks, one face of which is blank; another face divided by one black line (incised) dividing the face into two equal parts; another side is divided in similar manner into four parts; and the fourth side into eight. The remaining two faces are coloured, one black, the other white.

The first step is placing the black and white faces side by side alternately, (*a*) counting one black, one white, one black, are together equal to three blank faces; (*b*) one blank face is equal to 1 in., two black and one white are therefore equal to 3 in.; and developing thus by stages compatible with the ability of the children concerned, until the whole twelve blocks are placed in position. Additional interest is aroused and maintained if the blocks have been placed side by side on a piece of white paper, and the children are asked to draw a black-lead line round the whole, then to remove one block from the right-hand side and mark a line close against the remaining blocks, repeating the process until the last block is reached. The children again build up the black and white blocks in line, then are asked to cross-line in pencil the squares on their drawn "plan" which correspond to the black blocks in the line. Following the wood blocks full inch measure, coloured tiles 1 in. square and $\frac{1}{4}$ in. thick should be used, to show that it is only the surface measure we require; and to still further emphasise this point recourse is made to 1-in. squares of thin card.

Making sure that the division of the standard foot into twelve equal parts is grasped, practical measurements—*i.e.* the cutting to definite *lengths in inches* of various media, paper, wool, pulp cane, wood strips, tape, ribbon, or wire—follow. The children are led to understand that the cutting of these pieces of material is of some importance, because each piece will be required in the making of some article, either by themselves, or be placed in the stock-room ready for use when required by the senior class-workers. By this method keen interest is maintained, and each child is made to *feel important.* Nothing is to be done which does not form a part of a greater whole.

The subdivisions of the inch may now be undertaken, using the cube blocks as before in the first instance. Two black and one white blocks together are shown to be equal to three blocks with *one* line showing on the face of each (which divides the square face of each block into two equal parts). Hence it is seen that three wholes are equal to six halves. Statements by the teacher should be avoided, if possible, and efforts made to lead the children to give *own impressions of equality.* Follow

on with the fourth division of the inch; but do not fail to give practical measurement application at each stage of acquired knowledge. Let the practical cutting-up of the material be the actual test of the teaching; and should there be a considerable number of failures, at once revert to principles and revision.

With the brighter children—"higher-grade cases" is the accepted nomenclature—a further subdivision into sixteenths is possible, with the aid of 4-in. squares of paper folded into sixteen squares. This leads on direct to surface developments, in which two dimensions become necessary as the bed-rock principle of measurement used in such handicraft as cardboard-box making, sheet-metal and tin plate work.

The use of squared paper, *i.e.* paper ruled in $\frac{1}{4}$-in. squares (or less divisions of the inch) and counter-ruled in distinctive colour in square inches, cannot be too strongly advocated for all purposes where surface measurement and scale proportions are requisite.

Measurement is an Introduction to Occupations.—The preparation of workshop stock-room material—viz. wool, raffia and coir-rope, for mat weaving and making; willow, pulp or centre cane and wire for basket stakes and making; wood strips for garden edgings, trellis work and plant sticks; covering papers for box making; wrapping papers, cardboard blanks, wood bases for raffia work and basket sewing-trays and other "surface" work—will lead directly to cutting to curved and irregular lines (be they traced or copied, by the aid of patterns or templates) on materials to be used in the boot-making, tailoring, cutting-out and dressmaking, leather-working, metal-plate and tinware industries.

As a direct preparation for the two latter occupations, nothing is more suitable than work in paper and cardboard modelling. The necessary work is well within the capabilities of many of the "higher-grade" lads. Commencing with paper-bag and envelope-making and progressing by easy stages to cardboard-box making, considerable dexterity can be acquired without unduly taxing the mental or physical powers of any child.

Imitation only to be Used.—In no circumstances should the geometry of surface development be now attempted. The

imitative method only should be employed. The advice usually given to teachers by a well-known superintendent of Special Schools and institutions, seeking guidance in these daily difficulties, is worth recording here: *"Be experts yourselves, show how it can be done by actually doing it yourself with the children; you will then find no better copyist than the higher-grade mentally deficient person."*

The Danger of Monotony.—It may be truly argued that this preparation of material for future use in the workshops will not appeal to the children; that as nothing is being actually made, the work will have a deadening effect and become monotonous to both teacher and children. But such preparation is the foundation of modern industrial success, the basis of specialisation, and the very foundation of workshop efficiency and economic working; and must, therefore, not be ignored.

In the preparatory school every effort must be made by the staff teachers to counteract the tendency of monotonous work; in the early and easy stages it must be "play," in the secondary or junior shops "work-play," and in the final stages, from fourteen years of age and onwards, in the senior shops "serious preparation" to pass onward to the industrial workshops which must be established sooner or later under the new Act.

The Time Factor.—We have endeavoured to suggest that the foundation of the work in the latter must be commenced in the junior classes, and that sequence in progression is desirable until the age of fourteen, after which definite trade teaching becomes the chief feature of the training. We would further say that this underlying principle of thorough preparation should always be supplemented with what may be technically called the time factor. It is far too late to commence talking about completing certain jobs within a certain time, at the age of fourteen; the time factor must be introduced as early as possible during the "stock-cutting" periods, the children will readily "speed up" their efforts, if they are told how important it is for the credit of the school or class, that "the order for the stock-room has to be completed during the present lesson." As to ways in which to secure this end: jocularity often succeeds, story-telling has its place, genial and friendly competition is a potent force in creating the new atmosphere of a busy hive of industry and

helping to make the inert, inept, and moody individual more of a pleasure to himself and his class-mates.

The Teaching of Form and Colour.—Concurrent with the preparatory industrial training should be undertaken the teaching of form and colour For the former a definite course of plastic modelling is the foundation, and provides adequate training of the fingers, rendering them supple, sensitive, and facile. Be the media clay, plasticine, pulp paper, or wax, it can be used to aid the work in fractions, and to make more solid any abstract proposals of a third dimension problem. Without laying down any fixed rule of procedure, we submit the following as a framework upon which to build a complete training course suitable for special-school work up to the age of fourteen years.

Acquiring sense of quality or bulk: first, by observation; second, by feeling; third, by balance.

1. The formation of balls and globular forms, using the finger and thumb only. (*a*) Forefinger and thumb of each hand engaged on one piece; (*b*) forefinger and thumb of each hand used separately on two pieces, *i.e.* two balls are produced simultaneously, one by each hand.

2. Formation of rolls. (*a*) From given balls or bulk; (*b*) to required length and diameter

3. Building-up a slab or flat surface, from balls or rolls placed side by side. (*a*) Length and width; (*b*) making the third dimension thickness, thus training the sense of touch by feeling, *i.e.* holding the slab between forefinger and thumb of both hands, and by slight pressure where necessary flatten out the surfaces, thus gauging the thickness of it.

4. Building up solids from slabs and forming solids from balls and globular forms.

5. Formation of slabs, and cutting therefrom bricks in correct proportion. (*a*) From copy; (*b*) without copy.

6. Bricklaying, giving instruction in "bonding."

7. Slab work in building common objects suitable for examples, and assisting in "reading and seeing" the requirements essential to surface-development in cardboard and metal work.

8. Slab work as the basis of building-up natural and conventional globular or curved surface forms and ornament.

9. Simple and conventional tile making, ornament in relief and incised.

10. Modelling from nature, twigs, leaves, fruit, etc., with and without ground base.

11. Map modelling in low relief from flat copy.

12. Relief modelling with reference to physical geography or picture making.

Modified to suit the capacity of the children as to powers of manipulation and imitativeness, a course in plastics is of undoubted value and can be made the groundwork of much future industrial teaching.

The sense of colour is very strongly marked in many cases of mental weakness, and very little effort has to be expended in training these abnormals to acquire a complete mastery of colour treatment in bold masses. Experience shows that pastel or brush work adds materially to the joy and fascination of school life. The matching of tints in the junior classes can be taught concurrent with the practical cutting of wool and cloth for rug making, and the knowledge of the spectrum colours can be fixed by the use of coloured tiles or blocks during the number-teaching lesson.

It is not beyond the capabilities of many of the higher-grade children to invent the pattern of a rug or piece of weaving, if the groundwork of the process is taught by the aid of coloured strips of paper or laths, ¼ in. in width, threaded or woven into a sheet of paper or prepared cloth, slit in the centre into strips of corresponding width to leave a clear margin all round. The sequence of lessons would involve naming colours at sight, matching strips, harmonising for effect, contrasting for effect, number teaching, and construction.

Interest is maintained by reference to ancient ways of weaving, rush mats, wind screens, how birds interlace twigs and fibres in making their nests, how household linen and wearing apparel can be repaired, how men invented machines to do the same processes of interlacing fibre and wool in order to make large pieces of cloth, and how coloured materials enhanced the value of the work from the very earliest periods of history.

Resulting Occupations.—The elements being once grasped,

practical work quickly follows in the making of mats, tidies, etc., with the paper strips in the junior class; straw mats and raffia baskets in the junior shops; and weaving proper in the senior shops. Thus a course of simple mat designing, incorporating number and colour, will lead up directly to dexterity in the manipulation required in several occupations which are assuredly remunerative.

Ignoring the colour phase of the preliminary work in mat weaving, the occupation may be made the groundwork of cane and raffia weaving, Indian basketry, rush and cane chair bottoming, willow and splint basket making, and coir mat making, any or all of which have a definite remunerative possibility, if carried out in the senior shops on a correct commercial basis.

Teaching the Coinage.—Concurrently, or at least associated with the teaching of the value of linear and surface measurement, should be taught the value of the current coins of the realm. Every teacher engaged in special-school work knows full well the deep interest displayed by the children in "keeping shop," weighing, selling, and buying. All such interests are covered by our statement that *in the early and easy stages all instruction should be given through play.*

Elementary Woodwork.—Much diversity of opinion exists as to what can be considered elementary woodwork, because every piece of woodwork construction is composed of elements which in themselves are elemental, *i.e.* involving the same processes of tool work, the same "setting-out," and the same finish, as are required in the schemes of woodwork recognised by the Board of Education as Manual Training. The recent introduction of slabwood, whittling, jig-saw, and strip woodwork into the ordinary school curriculum as a phase of educative handwork undoubtedly makes a distinction between the work of the carpenter, joiner, or cabinet-maker, and that of the school class-room. We shall attempt to show that the higher phases suitable for the special-school workshop have a foundation in the strip woodwork construction, and that whittling and jig-saw work have a place in a general scheme of training of normal children between the ages of nine and twelve, or of children whose abilities approximate thereto.

The introduction of the knife and saw is assumed to have been made during the "practical cutting of stock materials" lessons, therefore we submit a groundwork which has proved efficient.

Whittling and Jig-saw Work.—Soft, clean-grained, white or yellow pine not more than ¼ in. thick is required, together with a number of templates or patterns of animals, birds and reptiles, human figures, geometrical forms, limbs of animals and men, and other similar outline forms, including maps of districts, counties, and countries. Colour-work is also included.

Briefly the method of procedure is as follows: Select a pattern within the scope of the average child in the class, then if possible let the children determine the size of the piece of wood required to copy the pattern; obtain the wood from the stock-room and distribute the pieces. Trace the outline (in black-lead) of the selected pattern and proceed to whittle—cut with knife, with and across the grain—away the waste material to the outline, then finish the rough-cut edges with file and glass-paper. Smooth off the flat surfaces with a glass-paper rubber, and proceed to colour where it is necessary.

As soon as the children acquire the knowledge to use the knife without splitting the wood along the grain, then more intricate forms may be introduced, and fascinating moving toys become a feature of the scheme.

The use of the jig-saw—a type of fret-saw with a much stronger blade—is brought in for cutting the more intricate curved edges, and for inlay or insertion work in map or picture making. A full range of patterns of equivalent difficulty will serve to give variety to the class work and materially aid the teacher in attempting knife work with a class of children impossible of ordinary classification. When movable parts are being fitted, care is necessary in boring the holes through which the joint connections are placed. For medium-sized figures, animals, etc., these holes should be ⅛ in. diameter, and be bored with a twist bit and archimedean drill stock. Bifurcated rivets of soft metal (aluminium by preference) and washers to fit should be used for jointing.

Strip Woodwork.—A few extra tools are required now, *i.e.*

a try square, a hammer, a small bradawl, and a cutting or sawing block, fitted with a piece of iron on which to clinch or turn over projecting nail points. The material required is clean-sawn strips of whitewood, pine, or spruce of various widths and thicknesses; the most useful being $\frac{1}{2}$ in. × $\frac{3}{16}$ in. or $\frac{1}{4}$ in, $\frac{3}{8}$ in. × $\frac{3}{8}$ in., $\frac{1}{2}$ in. × $\frac{1}{2}$ in., 4 in. × $\frac{3}{16}$ in.

The preliminary training should be so arranged to develop dexterity in nailing, as upon this operation will very largely depend the whole series of possible models. Knowledge of length having been acquired during the "practical cutting" lessons, very little difficulty is found in copying any given model. The scope of models is practically unlimited, and methods of sound construction are possible when a chisel is added to the equipment for the senior lads.

Models giving mechanical movement, bridges of various types—as cantilever, suspension, and girder—sheds, barns, and farm-houses, railway stations and landing stages, dolls' houses and furniture, house goods and chattels, loco. and traction engines, motor cars and aeroplanes, have all been constructed by children in special schools, since the introduction of light woodwork in 1903.

Teachers who are intending to make light woodwork the preliminary training-ground for the more strictly joinery or cabinet work in the senior section and the workshops are advised to consult any of the published text-books on light woodwork, and lay out a course of work suited to their own requirements and the capabilities of the children under their charge. The children very rarely tire of the work, and many quickly show marked, if not abnormal, ability in the use of the hammer and saw, and individual work of high quality both as to construction and finish is sometimes obtained.

The models made may be toys suitable for distribution at Christmas, as contributions to children's homes and hospitals, or, in the higher division, of saleable articles, such as hair and tooth brush racks, and soap boxes, brackets, tidies, pen and pencil-boxes for school use, photo frames and easels, etc., etc. The limits of possibilities are determinable only by the limit of resourcefulness of the teacher and the efficiency of the training.

Light Metal Work.—The introduction of forms of metal-work by some special-school teachers, and the success which has been obtained, more than justify a few particulars of some of the phases and processes possible. The choice of material will be determined by the particular kind of work it is desired to take up. Of the baser metals, copper, tin-plate, aluminium, brass, zinc, pewter, and duralumin are suitable for decorative work, whilst mild steel, bronze and hard-drawn copper in wire or strip (rolled, not sheared) are essential for wire and scroll constructions.

The tools required are simple and few in number, and the general equipment need not involve anything which cannot be used in any ordinary class-room; whilst the instruction necessary to produce effective results even in the lower classes is well within the capabilities of the class teacher who has little knowledge of handwork processes in general, but who is able to apply her acquired skill with pencil and brush in the production of artistic designs, which can be reproduced in any plastic or modelling media. As sheet metal is included under the latter term in this instance, all that is necessary to acquire is facility to modify the treatment of the media, so as to produce the desired result in the most effective way.

As with all the other occupations suggested in this article, the ultimate idea of vocation must be a determining factor—after the purely educational—in drawing up the scheme, or in conducting the work in the school class-room.

There is a more sure vocational end in a well-devised scheme of light metal-work than is possible with several of the occupations now being worked in the schools for physically defective children, many of whom have a keen perception of the artistic, and quickly grasp the rudiments of modelled metal-work in low relief.

We commence with what is sometimes called *stitching, i.e.* tracing the outline of a design by means of a dot-punch, which, when lightly struck with a small hammer (or a flat sea-rounded beach stone), makes an impression on the thin metal like a large full-stop, the metal being nailed down to a piece of soft pine-wood.

Grounding, using and following on with various forms of grounding tools in producing surface ornamentations, without

any attempt at modelling or raising; the required effect being obtained solely by the impressions made by the tools used. For a guide to pattern design at this stage, recourse may be had to the trade catalogues of printers' type makers, and intelligent observation of the wares to be obtained in the many bazaars and emporiums where fixed prices rule.

Piercing may next be attempted; first by means of direct punching out the holes required by means of punches, made from pieces of steel of square or round section not more than 3½ in. or 4 in. long and filed at one end to the size and shape required. For thin metal (copper, tin, pewter, zinc, or aluminium) a 3½-in. wire nail filed at the point end to the desired shape will answer all requirements.

Place the piece of metal face downwards on a block of cast lead, or a piece of hard wood cut from a tree bough or small bole, then with a well-directed hammer-blow drive the punch through the metal, thus cutting out the required hole.

If worked in conjunction with the advanced grounding, the value of both processes can be enhanced by making the holes to fit so-called "jewels," pieces of coloured facet glass, mother-of-pearl, coloured sealing-wax, or a contrasting piece of metal, these being held in position by cement, or a back piece of suitable material, according to the purpose for which the piece of metal-work is intended.

Attempts may now be made with *modelling in low relief* upon very thin metal—copper or aluminium sheet—laid on the soft pine working block, on which is glued a piece of thick felt, and using the ordinary box-wood modelling tools to make the impressions in outline as a preliminary to the more ambitious repoussé and hammered tooling. The use of these wood tools in working thin metals is of very ancient origin; it is more than possible that the remarkable beauty of some of the illuminating done by the ancient scribes on the initial letters of their script is due to the use of pure gold modelled and filled as required; certain it is that the art is lost and that modern gilding does not give the lustre of the ancient work.

The designs usually applicable to this stage of the work may be copied direct from low relief work in clay, plasticine, wax,

or wood carvings; in fact the metal is only another media of expressing the art of modelling.

Working from the front or back of the metal is permissible, the best method being determined by the required result. When the modelled surface is required to approximate to high relief, the ground or working block of soft pine is replaced by a thick pad of felt—such as is used in the kindergarten occupation of pin-piercing outlines. Care must be taken not to over-strain the thin metal by heavy pressure on the modelling tools, or fracture will result.

Although copper has a very high ductility and will stand rough usage to a most remarkable degree, constant working on a particular part will render the metal brittle; but the ductility may be restored by allowing the flame of a spirit lamp to play upon the part under treatment until it assumes a dull red heat, and then suddenly immersing the metal in cold water. The process is called annealing the metal. When cold, it can be again worked as before.

The work produced by this method can be used for embellishment of other pieces of work in wood, leather, or cardboard, being especially suitable for such saleable articles as glove, tie, handkerchief, and card boxes, brush backs, mirror frames, blotter covers, book corners, finger and name plates, match-box covers, belt buckles, and many other similar articles of utility which provide a good background for the cement filling, which is necessary to maintain the thin metal in the modelled relief.

It is now an easy step to *surface repoussé work* in thicker-gauge metals. The first attempts should be made with soft pine as the working block, and the piece of metal securely attached thereby by being turned over on two if not all edges and nailed parallel to the working face. The results will approximate to the work done by the previous method, but ordinary steel or metal tools will be used throughout.

Should the noise caused by the hammering be distracting to sensitive nerves, much of it can be avoided by placing the wood block on a close canvas bag filled with fine sand, which gives a fairly solid foundation, and consequently assists the hammer in raising the metal during the process.

As soon as facility in using these tools has been obtained and the children have become used to the more refractory material, the wood foundation gives way to the "pitch block," the orthodox medium for higher-class work in both baser and precious metals.

Further details will be found in the article on Repoussé Work in this volume.

Drawn wire work is another phase of light metal-work. The wire may be straight and crimped, coppered, tinned, or otherwise treated to minimise the tendency to rust. Here again the tools required are very few in number, and provided the wire does not exceed No. 12 Imperial Standard Gauge, the work will be found to be well within the physical powers of the children at twelve years of age.

Almost endless articles of utility and saleable value can be made, such as scewers, toasting forks, sponge baskets, soap baskets, flower holders, fire guards, grids, drainers, glass holders, menu stands, postcard and letter racks, boiling baskets and other kitchen utensils and receptacles. Careful observation by the enthusiastic teachers will add materially to the list, when once the tool manipulations are mastered. The chief feature of the process is adequate rigidity of the construction, without having to resort to soldering.

Definite measurement of the lengths of wire required for each element of the piece of work under construction must of necessity be an essential to completing or producing a saleable article; therefore care must be exercised in the selection of the workers, or some mechanical device must be adopted which will eliminate the chance of failure. With the lighter wire the stock lengths could be prepared by the juniors, as advised previously for other media; but for the heavy, some little difficulty is experienced.

Ribbon metal is the next development. This readily lends itself to ornamental treatment, either as a unit or when used in combination with sheet metal, plain or surface worked.

The work differs entirely from that known as "bent iron work," which is usually of such a flimsy and unstable character as to render it unsaleable.

The metal used for ribbon work is flat mild steel rolled cold from drawn wire to required thickness and width. For the light articles No. 19 I.S.G. and $\frac{1}{4}$ in. or $\frac{5}{16}$ in. in width is most suitable. For heavier work, gauges 16 to 13, $\frac{3}{8}$ in., $\frac{7}{16}$ in., and $\frac{1}{2}$ in. in width give strength and effect. Bronze, and an alloy of aluminium commercially known as Duralumin, are both suitable metals; the latter especially so as it possesses all the characteristics of mild steel with the added advantage of not being affected by rust.

The tools required are few in number in excess of those already required for the preceding phases. Two or three pairs of strong round-nosed pliers, two tapering beck-irons, a few bending pins ($\frac{3}{8}$ in. and $\frac{1}{2}$ in. pieces of tool steel rod about 3 in. long to be fixed in pairs in the bench vice), a few twist drills (No. 19 to $\frac{1}{8}$ in.), a small bench drill stand (hand wheel driven), a few rivet snaps and flat chisels, with one or two bench anvils (these may be disused laundry irons, mounted on a wooden stand or let into a tree bole 6 in. or 8 in. diameter) will be found sufficient for a class of ten or twelve lads.

To ensure saleable goods, it will be necessary to resort to mechanical methods in forming and copying the ornamental curves; a good plan is to follow the method adopted by the iron shipbuilders, *i.e.* peg out the required curve on a plane surface, placing the pegs inside and outside, at spaced distances, so as to form a guarded path or track. The metal strip must then be curved gradually until it fits between the pegs quite freely. A number of similar curves may then be reproduced alike in every detail. Very efficient pegs for this purpose are used gramophone needles.

The jointing together of the several elements of the piece of ornamental ironwork is either by paste soldering, rivets, or ball-head bolts and nuts; the latter being most effective upon large work in the heavy section metals.

Fire screens, lamp brackets, canopies, gas and electric globe holders, fire-iron dogs or rests, flower vases, fruit-dish supports, cake stands, grills, various racks for hanging and standing, table kettle stands—designs of which are available for adaptation to the observant instructor at almost every turn—are saleable

articles, entirely within the possibilities of the vocational section of institutional life.

There is no reason why metal toy making from sheet metal should not be a distinctive feature in continuation institutions for Mental Deficients of the higher-grade types. Such toys are imported from the Continent in very large quantities, and there certainly appears to be an opening for considerable development in this phase of metal working by the governing authorities of some of the residential schools and institutions which are making handwork a source of revenue.

It is not within the range of this article to give minute particulars as to methods and processes in carrying out courses of metal-work, rather is it to suggest possibilities and developments of work that are already being done in some schools, and to encourage other teachers to emulate the examples set by their colleagues, who are called upon to create a new atmosphere in which the children committed to their charge shall receive a moral and inspiring training, directly leading to true happiness and self-respect.

Heavier Woodwork.—*Carpentry, Joinery, and Cabinet Making.*—It has already been proved beyond question that in "elder boys' schools" woodwork on lines similar to manual training in American schools is quite within the mental and physical powers of high-grade mentally deficient lads of eleven years of age and upwards, and that, given craftsmen teachers, saleable articles of good construction can be produced; but so far as we know, no real attempt has been made in any Day Special School to systematise the manufacture of any marketable article, or to introduce machine-prepared details for ensemblement The instruction is given on general educational lines with a bias to vocational finish.

The making of such household articles as housemaids' boxes, racks of various kinds, step-ladders, footstools, chair-ladders or combination steps, soap boxes, dog kennels, nesting boxes, clothes airers, feeding troughs and other rough and semi-finished articles, could well be undertaken on a fixed time basis, provided a market could be found or created and a reasonable guarantee of delivery given.

At present the permissive character of the Education Act

which deals specially with defectives, militates against successful training of the lads in the schools named, even if the extended period, *i.e.* the two years from fourteen to sixteen, be entirely given up to trade teaching. Of necessity the progress made by these subnormals is very slow, and therefore a knowledge of the higher branches of these woodworking industries cannot possibly be acquired under existing conditions. The head teachers of such schools have to determine which phase of the work will be of most value to the individual concerned, and must arrange his curriculum and time-table accordingly.

The moral training of these lads being equally as important as is their future vocational training, a double factor is present which has no counterpart in the industrial workshops, and, therefore, specialisation up to the age limit of attendance is not possible.

The introduction of high-speed woodworking machinery into the school manual training or woodworking room would introduce an element of great danger, without giving an equivalent advantage, and unless machinery can be used for the preparation of the rough material, the productions of the half-trained inept cannot possibly enter into a competitive market. For these reasons, therefore, we do not advocate carpentry, joinery, and cabinet making as trades suitable for vocational training in special schools.

An extension of the woodcarvers' art, in the grounding of panels, pediments, chair backs, and other details of furniture, is very desirable; many of the lads are artistic in temperament and develop latent talent under careful tuition, which could be very easily made remunerative if more attention were directed to possibilities.

Raffia, Cane, and Willow Work.—While it is difficult to say truly why these two industries have found such favour with special-school teachers, the fact remains that, as far as we have been able to ascertain, every Special School working in the United Kingdom is now taking, or has taken, some phase of one or other of them. The cheapness of the material, low initial cost of the equipment, and the fact that a large proportion of the teachers are Froebelians who have been required to possess

[illegible] knowledge of the craft as handwork before being certified as efficient, are no doubt among the chief causes.

Certain it is that the children readily apply themselves to the work, and under expert craft teachers, become clever workers. Very much of the junior work in raffia is valueless as productive of revenue, owing to the amount of time required to produce anything like saleable articles, but it has a valuable educational end.

We have seen children, prone to very vicious habits, rendered tractable and docile under the fascination of pattern weaving, and others who showed no interest whatever in reading, writing, or number, enter freely into conversation with the teacher and discuss in their own way the particulars of form and dimensions of coiled basketry.

The work has a distinct effect in moral training, and for that reason alone must be considered of value. The readiness with which the most backward children "pick up" the technical terms, weaving, slewing, randing, staking, waling, and the facility with which they use them is positive proof of acquired knowledge through handwork. The procedure, so far as the simple weaving is concerned, is a foundation for the needlework lessons in darning and mending woven fabrics. In the American schools raffia is often introduced before the finer threads, because of its suitability for children of both sexes.

It would be advisable for the non-craft teacher to remember that the weaving process of fabric work differs considerably from that of the more refractory material, and therefore the technical terms which are used for one industry do not altogether apply to the other. The distinct use of professional or trade terminology and terms should be acquired from the trade teachers, and wherever the junior work in pith cane is intended to be the foundation of trade teaching the correct nomenclature should be taught from the commencement.

Possibly in no other industry—the elements of which are included in Special Schools Handwork—does the amateur work of the class teacher show up so strongly against that executed by the children under craft teachers. The cause is undoubtedly due to Froebellian training on strictly educational rather than on pre-vocational lines.

As many of the processes applicable to centre cane work are not applicable to osiers or willows, and as the latter chiefly concern revenue value, it appears to be politic to delegate this phase of basketry to the vocational classes, where under the specialist teacher the conditions of industrial shop practice will be fully acquired.

If attention be given in the lower senior classes—of both sexes—to the making of wood-base serving trays, tuscan straw bags, chair bottoming in cane and rush, and the covering of glass bottles, a certain amount of revenue can be gained without the industrial time-limit being a disturbing factor.

Storage of Cane and Raffia.—The storage of the centre cane and raffia is very often a difficult problem with staff teachers. Various methods have been adopted, but each has some inherent defect which prevents universal adoption. Perhaps, of the number known to us, the separate canvas bag is the best for ordinary purposes.

These bags—made of strong unbleached calico or twill—are about 6 ft. long by $2\frac{1}{2}$ or 3 in. diameter, open at both ends like a tube, and have four round rubber bands sewn in, under tapes, at equal distances of 2 ft., and each bearing a bold number corresponding to the size of the cane which it will contain.

On receipt of the bundles, the ties are released—except the coloured one at the doubled end which denotes the quality—and the doubled end pushed through the tube bag, expanding each rubber ring in passing, until about 4 or 6 in. of the doubled end projects beyond the end. The coloured tie is then removed and, if thought necessary, tied to the mouth of the bag. The bags may be suspended from nails or holdfasts driven into the wall of the store-room, or from some similar fitment in the class-room, the doubled end of the cane being downwards. It is then a very easy matter to withdraw a length, by taking hold of one of the loops and drawing it out about 4 in., then pulling out entirely one side of the loop, and finally the whole length. The rubber bands will close upon the remainder and keep all neat and tidy.

The hanks of raffia may be treated in a similar way, provided care be taken to remove any tanglement which may have been created by careless packing in the first instance, and that the

butt or stalk ends are clean cut across after the bag is put on. Do not three-plait or braid the hank when using the bags.

The storage of osiers and willows is a problem under any circumstances; but with a little forethought much of the present waste of material can be avoided.

On receipt of a "bolt," open it out and select the rods which you consider most suitable for particular phases of the work, as weavers, stakes, by-stakes, etc, remembering that a first sorting has taken place on the plantation, and therefore the "bolt" is considered by the growers and factors to approximate throughout to a certain trade name and quality.

For storage a series of open stalls - boxes about 2 ft. cube—with one face (excepting about 6 in. from the bottom) removed, and at varying heights above these iron rings (hinged to swing downwards) are fixed along a blank wall of the room; the butts of the rods stand in the boxes; and the tips are passed through the iron rings. Thus full facility is given for extracting any single rod without making chaos of the whole.

What Objects to Make. The crafts teacher will be best able to plan out a definite course of shop work suitable to the ability of each lad, therefore only an outline of possible articles of marketable value are here given. Square, oval, and round trays, square, round, and oval baskets (open and with lids), stick and umbrella baskets, round, square, and angular linen baskets, dog kennels and bird cages, tea stands with two or more tiers, garden chairs and tables, picnic, luncheon, and motor baskets, and in the heavy work, bottle and carboy casings, dress baskets, skips, and hampers.

All these are possible in institutions with lads and adults working under definite trade tuition and special supervision, and especially so when each worker is financially interested in the work into which he is putting his energy. It should be a feature of the vocational work of the special schools and institutions to encourage each worker to give of his best, by giving him or her a proportionate share of any revenue which may accrue from the sale of the goods produced.

Tailoring.—The introduction of clothes making and repairing into Special Schools has been so far marked with success, and there appears to be a distinct value attached to the training

given. Subnormal children do not object to monotonous routine provided the interest of production is maintained.

In a Day Special School all the paraphernalia of a tailor's, work-room may be in full use by lads of twelve years' average, carrying out the behests of a practical tailor. By carefully distributing the work of making a complete suit of clothes, the teacher can have each lad doing his best on the modern factory principles, where division of labour is the controlling factor.

Although the study of the human figure may not be attempted, the more expert of the lads may be trained to draft patterns on squared paper, from actual measurements—from a simple pocket, through the gamut of sleeves, collars, vests, pants, shirts, knickers, trousers, and coats. True block patterns may be used for particular details, but even in these cases lads show an intelligent knowledge of what is required of them. The results which are produced in finished and unfinished garments prove beyond any doubt that, given the right teacher, an excellent groundwork of what may be called a home industry can be obtained by both sexes in Special Day Schools where senior departments exist.

We are not called upon to discuss the work which is so efficiently done in residential institutions, where practically the whole of the clothes required by the residents are manufactured on the premises; rather are we concerned with such phases of preliminary vocational work which offer a reasonable return for the public money expended on a more or less permissive education. Broadly speaking, there does not appear to be any reason why clothes making and repairing should not be a strong feature of every Day Special School. It undoubtedly brings home life and school life closer together. Also it must tend to remove that element of neglect of self which is such a common fault with the lower-grade workers, and by so doing will have a moral influence for good on many who at present do little to keep themselves or their offspring decently clothed. When reconstruction is included in the scheme of work, the cost of material for instruction is considerably reduced. All that is necessary in this case is an adequate disinfection method, to avoid possible health troubles, and a careful supervision of the dismemberment of the disused clothing.

Boot Mending and Making.—What has been written above applies with equal force to the making and repairing of boots, clogs, and other footwear. The repairing section is always a popular one, and rarely can one find a boy or girl poorly shod in a Special School where leather work is carried out. The facility with which the elder lads use the hammer in preparing the sole leather on the lap iron is most marked.

The tools required for repairing are few and cheap, and can be obtained at any grindery establishment. An old laundry iron with or without the handle broken off or removed is an efficient lap iron; the pegging or cut-bill awl and sharpening strop may be home-made; and about 5s. will purchase the necessary iron foot, knife, hammer, nippers, glazing and forepart irons, rivets, brads, pegs, etc. It will not be necessary completely to duplicate these tools for the twelve or more lads in the class, and each instructor will determine for himself the full equipment.

Very little preliminary work is necessary before each lad is interested in preparing the worn heels of his own boot to receive the new half-heel pieces, which are often cut ready and bradded with two rows of cut-bill or French brads round the outer arc of the leather. After the heel of the old boot is prepared, *i.e.* the worn pieces removed to a straight line cut across the heel leather, the half-heel piece is fitted neatly to the edge and fixed in position by means of eight ⅝ in. rivets driven home into the lower heel leathers. Progress is quickly made by the lads, who really love to take part in the noisy operations involved. The removal of the worn soles follows, and demands a little more careful tuition to ensure good results.

The several little tricks of the trade are of themselves interesting, and are appreciated by the lads, who begin to feel that they are capable of really doing something worthy of commendation. The various lines of hand-made and machine-sewn boots provide a variety of operations which can only be mastered by the practice which is afforded the workers who have the run of a large school, in which are found all qualities of the bootmaker's art in all stages of repair and dilapidation. The wetting, flecking, drying, and hammering of the sole leather, levelling up the under-sole, are all independent operations, requiring just that amount

of simple care which the mentally deficient so readily give when interested.

There need never be lack of employment for those big lads who are almost beyond management, so long as one lets them know that one is looking to them to keep all the footwear in the school in order.

The work need not be entirely classified as suitable only for the boys, because there are operations in which elder girls can take a hand. Patching, both by the stitching and shiving methods, requires just that neatness of finish which is usually to be obtained from the girls who have had a full course of needlework, whilst several of the finishing operations, *e.g.* knifing up, paring, peening, buffing, heel-balling, and sock-fitting, can very well be done by them.

In the organisation of the school curriculum so as to include what may legitimately be called Home Industries, every opportunity should be given to include any necessary drawing, tracing, and number work, which may have a direct bearing on the economy of the material used in either industry.

Two of the most serious faults in the handwork methods as practised in Day Special Schools are the unnecessary waste of materials, and the absolute disregard of the wrong which is being done to the children in permitting them to acquire careless habits in planning without thought as to the value and cost of the material thus wasted.

In institutional life the discipline is of a more restrictive order, which tends to make the whole of the vocational work distinctly industrial, careful watch being kept to avoid unnecessary waste of materials in every department, with the result that much small repair work—especially in the two industries previously considered—costs very little, as the cuttings of new goods are utilised to the fullest extent.

Ornamental Leather Work.—*Leather Valise and Bag Making.*—It is claimed by some that the leather ornamentation is superior to carved and moulded work in plastics, especially where lightness and elegance with economy of cost are desirable. It is not affected by heat or damp, will not break nor chip, and it certainly improves with age. With children of special artistic

handwork ability—elder boys and girls—the occupation is fascinating, and it is also revenue earning. The materials required consist of prepared sheep-skin, technically called basil leather, which is usually nut-brown in colour and of fine texture. The waste cuttings from the currier's block, called shiver leather, are requisitioned for small details and filings.

The tools are few in number: a pair of cutting pliers, a veiner, a sharp penknife, a fine bradawl, a pair of fine-pointed scissors, wire of various sizes, liquid glue, and forming moulds as required, may be considered a full equipment.

The efficiency of the work is dependent almost entirely on the artistic temperament and craft ability of the teacher, coupled always with the power to impart the acquired technical skill and knowledge and to enthuse the children to emulate the procedure and methods of working as shown by the demonstrations.

The groundwork or preparatory stage should be work in plastics, copied from natural forms, leaves, flowers, etc; and the junior work, the cutting-out in outline simple leaf forms and petals ready for ensemblement. The work is essentially handwork, involving a free use of the fingers and thumbs in modelling the moist and pliant materials to the required forms. The modelling process approximates to that adopted for the metal modelling, as detailed previously, and the application of the finished products may also follow on the suggested lines. The extent to which development may be considered desirable must be determined by the teacher, as must also the precise nature of the tooling ornament and mounting of the panels or plaque.

Another phase of leather work especially suitable for girls, in which *suède* leather is used, is the manufacture of dorothy bags, string purses, belts, bows, and hat ornaments, which command a ready sale at very remunerative prices, especially so when modelled or hammered copper is incorporated in the productions.

Effective ornamentation is secured by punched, clean-cut holes round the margins of the bags, and the expanding pieces, through which is passed a narrow strip of leather to "overcast" the whole together. The suspending straps are secured to the

bag by leather knots, the armlet being a ring of oxidised copper wire of suitable thickness, flat or round and hammered to give it the necessary bizarre appearance. The belts are made according to the vagaries of fashion, *i.e.* parallel bands, shaped to fit given waist measurements, or of increasing width towards the centre. In some cases contrasting coloured leather is slotted or woven through clean-cut slits, or punched holes, or the edges are "overcast" with same material.

Many examples of good design may be seen in fancy shops, and other articles of feminine wear will readily suggest adaptation to the skilled teacher which can easily be made by the children. The work is particularly suitable for Day Special Schools where no attempt is being made to prepare for actual vocational work before the age-limit of sixteen years is reached.

In institutions further developments are possible, and sewn leather articles, dispatch cases, collar boxes, hair-brush cases, gun cases, golf bags, and valises may be produced under workshop routine and with standard equipment and sewing machines. The only drawback to leather work of any description is the increasing cost of the material required, and the consequent demand for high-quality work to compensate for the high prices charged in the retail establishments for the finished products.

Coir-mat Making.—The junior work should be on lines similar to that suggested for the Tenderfoot tests of the Boy Scouts Association, including full instruction in knotting, splicing, and slinging. Afterwards the pupils can be shown how old ropes may be utilised in mat making, thus leading direct to coir rope yarn making, to be later used in the manufacture of coir or "coco" mats.

The materials required are readily obtainable and the tools few in number, whilst the prices realised for first-quality productions give a wide margin of profit.

Brush Making.—In institutions where effective organisation is possible, one of the most remunerative of the possible vocations for elder boys is that of brush making. This industry offers many advantages, and provides adequate facilities for division of labour methods, by which both "inepts" and "higher grades" can be kept fully employed. The rougher class of both brushes

and brooms, such as scrubbing, shoe, grate, bannister, sweeps', and saucepan brushes, and bass, hair, and carpet brooms, are all within the range of possibilities under careful training and supervision by craft teachers.

Other possible vocations, especially in Institutions for After-Care, are french-polishing (for both sexes), upholstering (for both sexes), baking (for both sexes), house painting and cleaning, bee keeping, poultry farming, and laundry work for adult females, with horticultural and agricultural work for adult males.

For the higher-grade type of girl patients, lace making, machine knitting, needlecraft, including machine work and plain sewing, offer suitable employment, and give that touch of refined home life which materially adds to the moral training and well-being of the inmates of those institutions which are at present continuing the education, mental, moral, and vocational, of such as are passed on from the Special Day Schools.

BOOKS FOR REFERENCE

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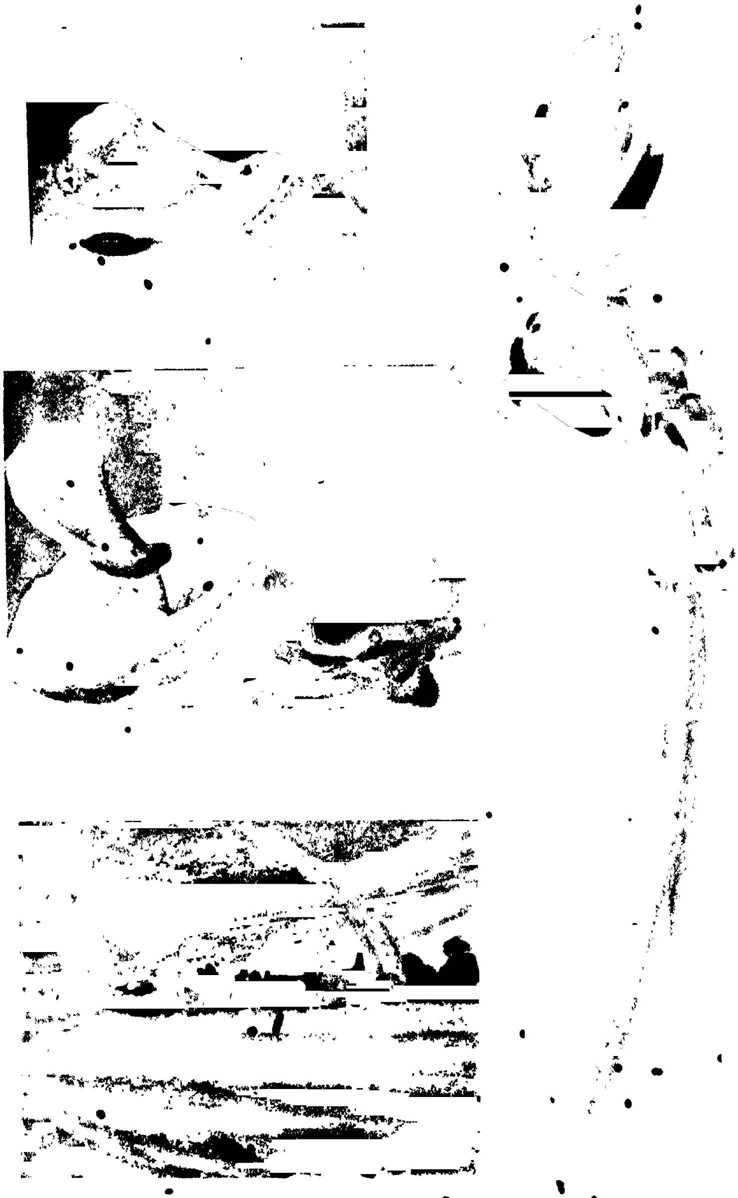
PLATE XII (Frontispiece)



THE MASTERY OF TECHNIQUE—BRUSHWORK FROM THE TRAINED HAND